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DESCRIPTIVE AND ILLUSTRATED CATALOGUE

OF THE

FOSSIL REPTILIA OF SOUTH AFRICA

IN THE

COLLECTION

OF THE

BRITISH MUSEUM.

BY

RICHARD OWEN, C.B., F.R.S.,

SUPERINTENDENT OF THE DEPARTMENTS OF NATURAL HISTORY.

"Semper aliquid novi Africa affert."—PLINY, I. viii. 16.

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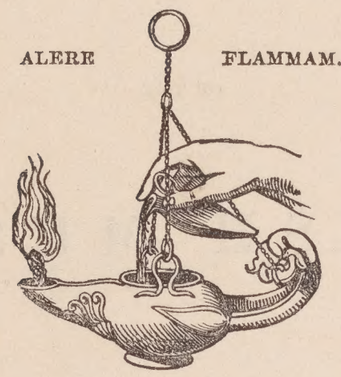

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Among the contributors of specimens therein described and figured may

PREFACE.

THE Fossil Remains described and figured in the present Catalogue are derived from districts in the colony of the Cape of Good Hope between latitudes 31° 45′–33° 30′ S., and longitudes 22°–28° E.

The first examples were discovered in the year 1838 by ANDREW GEDDES BAIN, Esq., an engineer employed in the construction of certain military roads on the northern and eastern frontiers of the Cape colony. The locality of the first discovery was to the north of Fort Beaufort, near to Mildenhalls.

An account of this discovery, with notes on the fossiliferous beds, was communicated by Mr. Bain to the Geological Society of London *, in a letter dated "Fort Beaufort, April 28th, 1844." Further details appeared in local journals at the Cape, in which Mr. Bain states that the rock from which parts of the protruding fossils first attracted his attention was "exceedingly hard, and so amalgamated with the bone that it was not only difficult to separate the one from the other, but even to distinguish which was which" †.

The fossils which, at that date, had been collected were transmitted by Mr. Bain to the Geological Society for determination and description. They were submitted for that purpose to the writer; and the cost of relieving the fossils from the matrix was, in the first instance, defrayed by HENRY WARBURTON, Esq., M.P., then President of the Society. Descriptions and figures of the specimens so extricated were appended to Mr. Bain's "Letter;" and the "Balance of the proceeds of the Wollaston Fund" was awarded by the Council of the Society, 22nd January, 1845, to Mr. Bain ‡.

The circumstances under which the subsequent collections of Mr. Bain

* 'Transactions of the Geological Society,' second series, vol. vii. 4to, 1845–1856, p. 53.

† 'The Eastern-Province Monthly Magazine' for September 1856 (8vo, Graham's Town), p. 7.

‡ See letter to A. G. Bain, Esq., Royal Engineer Department, Graham's Town, in the Minutes of the Council of the Geological Society, communicated by Mr. Bain to the 'Eastern-Province Monthly Magazine,' *loc. cit.* p. 14.

Geol.3708.76

became deposited in the British Museum are given in the following paragraph of the "Report of the Council of the Geological Society," published in the record of the Anniversary Meeting, February 18th, 1853:—"During the past year Mr. A. Geddes Bain, the indefatigable explorer of the geology of South Africa and discoverer of the Dicynodon, forwarded to the Society, from the Cape of Good Hope, four additional cases of fossils, chiefly consisting of bones imbedded in a hard matrix of limestone*, nineteen boxes containing similar remains and rock-specimens having been sent previously. The Council, feeling the great interest that is attached to these fossils, but, at the same time, not having at their disposal the means requisite for extracting them from the matrix and preparing them for the study of the anatomist, applied to Professor Owen for advice. Professor Owen, after due consideration, recommended that the fossils should be transferred to the British Museum, with a view to their being extracted and made available for science. He, at the same time, recommended that it should be represented to the Trustees of the British Museum that, in his opinion, the sum of £150 would be a reasonable remuneration to Mr. Bain for the expense he had incurred in collecting the fossils and forwarding them to the Cape. The Council acted upon both these suggestions, and shortly after had the gratification of receiving a letter from Sir H. Ellis, expressing the thanks of the Trustees for the offer of the Cape fossils, and informing them that the sum of £150 had been awarded by the Trustees to Mr. Bain, as some remuneration for the heavy charges he had incurred" †.

The singular modifications of reptilian structures manifested by the first received and described fossils stimulated further and continuous researches; and, through the liberality of the original donor and of other scientific residents and travellers in South Africa, specimens have reached the British Museum almost year by year to the present time.

The process of extricating the organic remains from their matrix has been carried on *pari passu*; and the specimens so developed have been deemed to require the present Illustrated Catalogue, which was directed by the Trustees to be prepared in their 'Minute' (at a Committee) of June 13th, 1874.

* Subsequent analysis has failed to detect lime; the matrix is a petrified quartzose mud or sand, throws off sparks when struck with the iron tool, and also, in some instances, as Mr. Bain remarks ('Eastern-Province Monthly Magazine,' *loc. cit.* p. 9), emits "a fetid smell."—R. O.

† 'Quarterly Journal of the Geological Society of London,' vol. ix. (1853), p. ii.

Among the contributors of specimens therein described and figured may be noted :—

His Royal Highness the Duke of Edinburgh, who, in an excursion to the fossiliferous localities of the Cape of Good Hope in 1860, obtained, amongst other specimens, the evidence of the new species of bidental reptile which bears his name *.

His Excellency Governor Sir George Grey, K.C.B., through whom the first example of a Theriodont Saurian was received †.

His Excellency Governor Sir Henry Barkly, K.C.B.

Thomas Bain, Esq., son and successor as engineer at the Cape to the discoverer and principal donor of the South-African fossils.

R. N. Rubidge, Esq., M.B.

Professor Rupert Jones, F.R.S., through whom interesting specimens have been received.

Professor John Morris, F.G.S., of University College.

As contributors of rare specimens for determination and description in the present Catalogue, with permission to mould and retain casts of such specimens in the British Museum, are to be noted :—

The Direction of the Museum of Natural History at Capetown.

The Direction of the Museum of Natural History at Albany, Cape of Good Hope.

The Direction of the Museum of Natural History at Graham's Town, Cape of Good Hope.

* *Ptychognathus Alfredi*, No. S. A. 86, p. 51, Plate L. See letter of his Royal Highness in the 'Philosophical Transactions,' 1862, p. 455.

† No. S. A. 46, p. 23, Plate XIX. figs. 6–11. See also 'Quarterly Journal of the Geological Society,' vol. xvi. (1859), p. 58.

The locality and the donor, or other source, of each specimen are noted after its description, presentation being indicated by the letter "[P]," from which it will be seen how largely science and the British Museum are indebted to W. Guybon Atherstone, Esq., M.D.*, who has devoted the leisure of a long and successful medical practice at the Cape to the study and acquisition of evidences of the palæontology of that part of the globe.

From the observations of Andrew Geddes Bain † and his fellow explorers ‡ of the geology of the Cape, we learn that, before the continent of Africa, as it now is, existed, the animals which have afforded the subjects of the present Catalogue lived, died, and propagated their kinds, through untold generations, in and near a vast body of fresh water occupying an extensive tract now elevated into mountain-ranges, attaining, *e. g.* in the Drakensberg range, an altitude of upwards of 11,000 feet. In the preexisting lake or lakes these dragons (*Reptilia*) frequented the banks and waters; and many of their carcasses sank and rotted in its sediments. Some notion may be formed of the duration of this life-scene by the ascertained vertical thickness of the fossiliferous lacustrine deposits in the following richly productive localities:—Stormberg beds, 1800 feet; Beaufort beds, 1700 feet; Koonap beds, 1500 feet; Karoo shale, or Upper Ecca beds, 1200 feet.

Actual Africa, in latitudes north of the Cape, still shows freshwater lakes surpassing in extent those of other continents; but the chief lake-basin of the ancient continent, part of which is represented by these reptiliferous deposits at the Cape of Good Hope, much exceeded in extent Tanganyika, or any of the inland freshwater seas which have been discovered by recent explorers.

The attempt to conceive or give intelligible utterance to the sense of past time since the reptiles of South Africa existed in the now upraised lacustrine area becomes oppressive; the terms in which we reckon up phases of the

* See his instructive Lecture, delivered at the Cape General Institute, Graham's Town, and published in the 'Eastern-Province Monthly Magazine' for June 1857, pp. 456 and 580, with geological sketches and sections of the fossiliferous localities.

† 'Geological Transactions,' *tom. cit.*; and "Geology of South Africa," a lecture delivered by A. G. Bain, Esq., at the General Institute, Graham's Town ('Eastern-Province Monthly Magazine,' vol. i. p. 396).

‡ Joseph Millard Orpen, Esq., Government Surveyor of the Cape of Good Hope; Charles E. H. Orpen, M.D.; Dr. Atherstone. See also "Section of the Zuurberg," by R. N. Rubidge, Esq., M.B. ('Eastern-Province Monthly Magazine,' vol. i. p. 187).

Among the considerations which [illegible]

world's history in connexion with human existence, are wholly inadequate to convey a clear or comprehensible idea thereof. We are driven, in the endeavour to realize a conception of prehistoric time, to resort to an artifice akin to that to which the astronomer has been compelled in order to conceive for himself, and convey to others, the relations of space which his instruments and calculus have discovered.

The multiplication of millions of miles leaves as vague an idea of remoteness of our planet to the nearest fixed star as the multiplication of millions of years expresses the conviction of the geologist as to the periods needed for the deposit of the thousands of remaining vertical feet of stratified sediment composing even a small subdivision of any of his great natural groups or systems of formations.

The ascertained velocity of light yielded the astronomer a more simple, more graspable expression of comparative distances. Light traverses the diameter of the earth's orbit in a quarter of an hour; it moves at a velocity of 193,000 miles in a second of time. From the nearest fixed star a ray of light takes three years to reach the earth; from Sirius sixteen years. A nebula, near or bright enough to enable the photographer to secure a recognizable image of it, exerts for the purpose a form of force, or sends its ray of light, which takes six hundred years in reaching and affecting the instrument and the optic nerve of the human artist. Hence the convenience of defining cosmical spaces or distances in the terms of "light-years."

So with the geologist: having approximatively estimated the period required for the formation of a constituent of the quaternary, tertiary, or other period, he substitutes, for numerical aggregates of historical years, the expression that such or such an organism existed and became extinct in such or such a formation—prior, *e. g.*, to the Liassic period, as in the case of the Dicynodont reptiles. The name of the formation gives to him an idea, of the distance of time since these and other subjects of the present Catalogue lived, more intelligible than could any row of figures summing up estimates founded on observations of the rates of deposit, of wear, of elevation, or of depression of the several strata of the earth's crust.

What the geologist requires in order to receive, in these terms, the

solution of his question as to the period of existence of the South-African reptiles, is the evidence of the age of the formations in which their remains became fossilized. The grounds on which geology founds its conclusion of such age in relation to the "Karoo series" of South Africa, as of the contemporary Panchét beds of India, will be found in the works cited below*. Every specimen described in the present Catalogue, of which the locality has been determined, has come from the divisions of that series known as the "Beaufort" and "Stormberg beds." The latter are the later. But amongst the rich abundance of fossil vegetation in these lacustrine deposits not one example of a cycadeous plant, or other indication of a liassic or oolitic age, has accompanied the vertebrate fossils. The remains of *Glossopteris* are of a species (*Gl. Browneana*) which has never been met with, like the Cycads, in a formation of oolitic age, but is associated in India and Australia, as in South Africa, with palæozoic evidences.

The question lies between the triassic and the upper carboniferous periods; but the more generally adopted reference of the Beaufort beds and, especially, the Stormberg beds to a triassic age has been provisionally assigned in the notices of the localities in this Catalogue.

The determination of the batrachian double condyle in the *Petrophryne* (S. A. 118) from the reddish sandstone of the Tafelberg in the Queenstown district proved its Labyrinthodont affinities, which were indicated by other cranial structures, as a similar demonstration in the *Brachyops*† had previously determined the presence of a Labyrinthodont reptile in the Mángali formations of the Kamthi group in India. Fragmentary evidences, most probably Labyrinthodont, and indubitable fossils of a Dicynodont, concur, with the plant fossils, to show the geological correspondency of the Panchét and Kamthi groups in India with the Beaufort beds in South Africa.

* Bain and Atherstone, *ut suprà*. Sutherland, Dr. P. C., "Notes on the Geology of Natal, South Africa," Quarterly Journal of the Geological Society, vol. xi. p. 465. Rubidge, Dr. R. N., "On some Points in the Geology of South Africa," Quart. Journ. Geol. Soc. vol. xv. p. 195. Stow, C. W., Esq., and Huxley, Prof., "On some Fossils from South Africa," *ib.* vol. xv. pp. 193, 555, 642. Tate, R., Esq., "On some Secondary Fossils from South Africa," Quart. Journ. Geol. Soc. vol. xxiii. p. 139. Griesbach, Charles Ludolf, Esq., "On the Geology of Natal," Quart. Journ. Geol. Soc. vol. xxvii. p. 53. Oldham, Thos., LL.D. &c., 'Memoirs of the Geological Survey of India,' 4to. Huxley, Prof., "On Vertebrate Fossils from the Panchét Rocks," in the above 'Memoirs,' 4to, 1865. Blanford, H. F., Esq., "On the Age and Correlations of the Plant-bearing Series of India," Quart. Journ. Geol. Soc. vol. xxxi. p. 519.

† Owen, Prof., "Description of a Cranium of a Labyrinthodont Reptile from Mángali, Central India," Quart. Journ. Geol. Soc. vol. xi. p. 37.

Among the considerations which weigh towards the palæozoic age is the arrest of vertebral development, or retention of embryonal characters, in the centrum of these South-African Reptilia, a character which is exceptional in liasso-jurassic Reptilia; and that exception, exemplified in *Ichthyosaurus*, is adaptive, as in fishes, in relation to an aquatic medium of life and locomotion. In those South-African Reptilia which, from their jaws and dentition, were herbivorous, and, from what is known of their limbs, more terrestrial than aquatic, the proportion of the primitive notochord retained in their vertebral column, indicated by the term Tretospondylia (Nos. S. A. 1–31), offers a closer analogy to the condition of that column in the early air-breathing Vertebrates of the Carboniferous series than to any Dinosaur of the Mesozoic formations.

A specimen of fossil fish (*Hypterus Bainii*, Ow.), transmitted with reptilian remains from the Beaufort beds at "Alice," near Fort Beaufort, belongs to a heterocercal genus near akin to *Amblypterus*, with close relations to other Ganoids of the Carboniferous formations.

The answer, then, to the question of the geologist as to the age of the South-African Reptilia, at the present phase of evidence, is, that they are not later in time than the Trias, and probably lived in the Palæozoic period.

Those, however, to whom such reply is in any degree intelligible form but a small proportion of the numbers visiting the British Museum who may give an intelligent glance at these singular fossils, and more or less comprehend the facts and deductions by which creatures so long extinct have been restored, so far, at least, as to enable the naturalist to assign to them their place and affinities in the zoological system. By such visitors the question naturally asked is, "When did these dragons live? and how long ago is it since they died out?"

To assist the comprehension of the grounds of a reply a "Tabular View of the Fossiliferous Strata," in the order of superposition, is subjoined (p. xii).

Among the most recent of these strata (viz. the turbary deposits, or accumulations of peat, still in course of formation) there are found evidences of Man, with remains of red-deer, roebuck, wild boar, the small indigenous ox (*Bos longifrons*), &c.; but the conditions under which the great vertical

extent of these deposits have been accumulated in certain localities yield ground for an estimate of a considerable lapse of historical time.

When such beds of peat have been dug out, they are seen, in many localities (*e. g.* in Ireland, the Isle of Man, and adjacent coast of England), to have rested on a deposit of white marl, of a fine tenacious consistency, and forming a good manure for oat- and potato-crops, due, in part, to remains of successive generations of freshwater mollusks which flourished in the ancient lakes of which the marl formed the bed. In this marl are found remains of the reindeer, the *Megaceros*, the hairy northern elephant (*E. primigenius*), and of other large extinct beasts, which roamed from Northern Europe over a land extending into the Atlantic, parts of which continent now remain in an insulated state, as "Great Britain," "Ireland," the "Isle of Man."

Since the deposits of "shell-marl," and of the corresponding lacustrine or freshwater formations of "brick-earth," both the geographical and climatal conditions of those parts of Europe have changed.

The legend of the loss of Earl Godwin's lands—the evidence of the monuments of the old monks transferred to Chichester Cathedral when the sea began to gain upon their Abbey, with the indication given by "Selsey Bill" of the whereabouts of the submerged lands of the Saxon Earl on which the Abbey stood (about halfway, now, between Bracklesham and the east end of the Isle of Wight)—the submerged forest exposed some twenty feet below the actual sea-level in excavating the docks at Jarrow Slake,—these and many other examples of slow and gradual change, such as still affects the Norfolk coast, operated to the remotest bounds of recorded time and long antecedent to history or legend. They indicate part of those changes in the disposition of sea and land which, being concomitant with analogous changes of the American coast affecting currents and causing "gulf-streams," put an end to the glacial climate which previously prevailed in our latitudes.

The evidences of the human species as we descend in the Quaternary series are mainly reduced to rude implements of stone; and all who have, without prepossession, intelligently studied these evidences, and the conditions of their discovery, whether in caves or drifts, are at one in defining them as "prehistoric." Beyond the Quaternary series reliable evidences of Man are not known to the writer.

During the Pliocene division of tertiary time, in which lived many mammals the species of which have now passed away, we infer, from the geographical correspondence of their distribution with that of their existing allies, that the main features of the actual distribution of land and sea, in regard to the larger continents, had been attained.

In the Miocene and Eocene periods other geographical conditions prevailed, with other climates. Correspondence in localized distribution of recent and fossil species can no longer be predicated. But significant evidences of the origin of existing species are found. The miocene *Hipparion*, with the pair of hooflets dangling behind the main hoof in each foot, has made intelligible to anatomy the veterinarian's "splint-bones" concealed beneath the skin of the fore and hind feet of the pliocene and modern Equines. The eocene *Palæotherium* shows the hooflets of the three-toed miocene horse in more normal and functional proportions. A similar progressive specialization is traceable from an artiodactyle type of quadruped, as represented, *e. g.*, by the eocene *Anoplotherium*, to the useful cloven-hoofed ruminants of the human period.

The biological, geological, geographical, and climatological phenomena of the tertiary divisions of time baffle all endeavours to conceive the number of annual revolutions of the globe during which these changes and advances in organic life were in progress.

To so test or define the periods of formation of the grander and more numerous subdivisions of the Secondary or Mesozoic series becomes a vain effort of the limited faculties of a finite nature. Yet nearly all these periods have come and gone since the reptilian animals played their parts in the triassic and permian worlds.

It is hard to realize the surpassing interest with which the evidences of such ancient life are first received, scrutinized, and compared, and by which is lightened the labour of gaining ideas of the frames, the limbs, the weapons, and ways of life of these long-since perished animals. Unlike the poet, and dealing with denser elements, the geologist nevertheless, but with eyes fixed and gaze intent, "bodies forth the forms of things unknown," "turns them to shapes," and, in the transitory continents which successively come into and fade away from his field of vision, gives to them "a local habitation and a name."

extent of these deposits have been accumulated in certain localities yield

QUATERNARY or PSYCHOZOIC.	Turbary. Shell Marl. Old-valley Drift. Brick-Earth. Glacial Drift.	Bone-Caves.	Pleistocene.	**MAN.** by Remains. by Weapons.			
	Norwich and Red Coralline Crag.		Pliocene.	**MAMMALS** under present geographical distribution. Equus.			
TERTIARY or NEOZOIC.	Faluns. Mollasse.		Miocene.	Hipparion.	Birds, Orders of.	Quadrumana. Proboscidia.	Orders of Placentalia.
	Gypsum &c. London Woolwich Clays.		Eocene.	Palæotherium. Toothed Birds.		Rodentia. Carnivora.	
SECONDARY or MESOZOIC.	Maestricht. Upper Chalk. Lower Chalk.		Cretaceous.	Cycloid Ctenoid Fishes.			
	Upper Greensand and Gault. Lower Greensand. Weald Clay. Hastings Sand. Purbeck Beds.		Wealden.	Procœlian Crocodiles. Toothed Birds and Pterodactyles. Iguanodon. Spalacothere, and other pouched Mammals.			
	Portlandian and Kimmeridgian. Oxfordian. Kellovian. Forest Marble. Bath-Stone. Stonesfield Slate. Lower Oolite. Lias. Bone Bed.	U. M. L.	Oolite.	Pliosaurus, Omosaurus. **AVES**, by Bones and Feathers. **MARSUPIALS**: Amphithere &c. Ichthyopterygia. Cephalopods (2-gilled).			Homocercal Ganoids.
	Keuper. Muschelkalk. Bunter.		Trias.	Tretospondylia. Theriodontia. Anomodontia.	S. Afr. Reptilia.		
PRIMARY or PALÆOZOIC.	Marl and Sand. Magnesian Limestone. Red Sandstone.		Permian.	Labyrinthodontia.			
	Coal-Measures. Mountain Limestone. Carboniferous Slate.		Carboniferous.	**AMPHIBIA**, Ganocephala.			
	U. Old Red Sandstone. Caithness Flags. L. Old Red Sandstone.		Devonian.	**PISCES** ganoid. placo-ganoid. placoid.			Heterocercal.
	Ludlow. Wenlock. Llandovery and Caradoc. Llandeilo. Lingula Flags. Cambrian.		Silurian.	Echinoderms. Annelides. Bivalves. Trilobites. Pteropods. Brachiopods. Gastropods. Cephalopods (4-gilled).			
				Brachiopods.	Trilobites.	Fucoids.	Zoophytes.

CATALOGUE

OF THE

FOSSIL REMAINS OF REPTILIA

OF

SOUTH AFRICA.

Class REPTILIA.

Order DINOSAURIA.

Section TRETOSPONDYLIA.

Genus TAPINOCEPHALUS*.

Species *Tapinocephalus atherstonii*, Owen.

This species is represented by the anterior extremity of the upper jaw (No. S. A. 1, figured, of the natural size, in Plate I.), and by part of the lower jaw and of the vertebral column.

In the specimen S. A. 1 the osseous substance has been partially worn away from the upper surface, and the premaxillaries have been depressed a little below the level of the maxillaries; but the contour of the upper surface supports the conclusion as to the original low, depressed form of the broad, obtuse fore part of the skull, expressed in the generic name proposed for the present form of huge South-African reptile.

The alveolar border of both premaxillary and maxillary bones has been worn down; but indications of low partitions supported an inference that the so defined compartments had contained subequal and serial teeth, of which, however, no trace was here visible. The general appearance of the fossil indicates that it has been rolled and waterworn.

The reptilian character manifested by the bony structure led to the test of the soundness of the inference as to the lost dentition by a section of part of the alveolar border in quest of the deeper-seated germs of the successional teeth. The appearances of this section are faithfully given in the right side of figure 1. Five teeth in different stages of formation were thus brought to light. The one most advanced, *a*, has a form in transverse section like that in the upper teeth of *Iguanodon* and *Pareiasaurus* (Nos. S. A. 13–15), but resembles the latter in the absence of the longitudinal ridges which mark the inner and less-convex side of the tooth in *Iguanodon*. The corresponding side of the tooth-crown in *Tapinoce-*

* Gr. ταπεινὸς, low, depressed; κεφαλὴ, head.

phalus is transversely undulate, convex at the middle and concave at each side to a subtrenchant and probably serrate border. The outer side of the crown was uniformly and more boldly convex. At the cut part of the crown is shown an entire and continuous coat of enamel, enclosing a body of hard dentine. This tooth must have been near its eruption, if it had not partially emerged; but no trace of it was visible prior to its exposure by the section. Of the next tooth in the series, the summit of the crown, *b*, showing a flatter inner surface and less convex outer one, is exposed in a depression or formative chamber, on the inner side of the alveolar compartment, in which only traces of the end of a fang, *b'*, appear. The section through the germ-tooth *c*, indicates it to have pushed its crown beyond the level of *b*. The germ *d* shows a greater breadth of crown, the shell of which seems to have yielded, like the mandibular germ-tooth of *Pareiasaurus* (Plate VIII. fig. 2), to some extraneous pressure. The base of the tooth *e*, which the germ-tooth *d* was about to succeed, shows the loss of substance on its inner side through absorption excited by the pressure of its successor.

We have in all these phenomena evidence of the dental conditions characteristic of the cold-blooded air-breathing vertebrates, with minor characters indicative of the affinities of the extinct reptile. On the upper, moderately convex, surface of this cranial fragment are traces of the pointed ends of nasal bones meeting the ascending and retrograding nasal branches of the premaxillaries. The palatal portions of these bones (Plate I. fig. 1, 22) appear to underlap in a pointed form the bone, or pair of bones, forming the middle tract of the palate. For further insight into the cranial structure, a vertical transverse section was made at the part indicated by the dotted lines in fig. 1. The osseous structures exposed by this section are represented by the darker-tinted, finely cancellous structures in fig. 2. The nasal bones are denoted by the number 15, the divided vomer by 13, the palatines by 20, the maxillaries by 21. If the determination of median prominent bones on the palatal as 13 be just, an affinity of the great flat-headed South-African reptile to the Crocodilian order is indicated. The vomer may be divided, and appear upon the bony palate, in certain Dinosaurs as in certain Crocodiles (*Alligator niger*, e. g.)*.

From a triassic formation "four miles from Jan Willem's Fontein," Cape of Good Hope. Discovered by the donor, W. Guyton Atherstone, M.D. [P.].

No. S. A. 2. A fragment of the dentary element, near the symphysis, of the lower jaw of *Tapinocephalus atherstonii*: Plate II. fig. 1.

Of this fragment a section has been made along a part showing faint indications of alveoli; and the lower portion of the section, in the present specimen, exposes the inserted roots of five of the serial teeth, behind which are indications of three successional teeth. The roots of the serial teeth are represented by the transverse sections, which, were it certain that they had been taken at the exact horizontal level of the alveolar border, would indicate different stages of formation, or wear, or progress towards shedding. The germs of the successional teeth show but a thin exterior layer of calcified dentine coated by enamel.

If the fully formed crowns of the serial teeth were expanded and marginally serrated, after the type of those in the genus *Pareiasaurus*, they may have touched or slightly overlapped each other in the perfect skull.

From a triassic formation "four miles from Jan Willem's Fontein," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

No. S. A. 3. The upper portion of the same section, reduced to transparent thinness for the application of the microscope: Plate II. figs. 2 & 3.

This demonstrates the part of each tooth cut through to be composed of hard or compact dentine, *d*,

* 'Descriptive Catalogue of the Osteological Series in the Museum of the Royal College of Surgeons of England,' 4to, 1853, p. 166. no. 764.

what glistening appearance. The proportions of length to breadth are nearly the same as in the preceding

with a thin coat of enamel, or vitro-dentine, *e*. The dentinal tubuli diverge at nearly right angles from the pulp-cavity to the outer surface of the tooth. They describe a feeble curve at their origin, and then run straight to the periphery, where a slight upward bend is indicated by the varying distances of their terminations. The diameter of the dentinal tubule is $\frac{1}{25000}$ of an inch; that of their interspaces is $\frac{1}{10000}$ of an inch. The enamel, *e*, covering the germ-tooth (ib. fig. 2, *a*; somewhat magnified in fig. 3) shows it to have been characterized by fine, equidistant, longitudinal ridges.

This satisfactorily yields two negative facts, viz. the absence of the inflected folds of cement, or vitro-dentine, which characterize the teeth of the Labyrinthodontia*, and the absence of the intermingled vascular canals which characterize the inner half of the crown of the tooth in *Iguanodon*†.

From a triassic formation "four miles from Jan Willem's Fontein, Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 4. A mutilated centrum and base of the neural arch of a dorsal vertebra of *Tapinocephalus atherstonii*.

The chief distinctive character of this vertebra is a perforation, half an inch in diameter, in the centre of each of the almost flat terminal articular surfaces, which must have been, when entire, between four and five inches in transverse extent. The length, or antero-posterior diameter, of the centrum is two inches and a half. To test the character of the seeming perforation, this vertebra was bisected vertically and lengthwise. The canal, so exposed, extends toward the centre for half an inch without change, then contracts rapidly, forming a cone, the apex of which would seem to have communicated, in the central part destroyed by the lapidary, with that of the corresponding cavity or canal from the opposite articular surface; about a line's breadth of the osseous texture intervenes at the subcentral part here exposed. The neural canal equals, in vertical diameter, half that of the centrum, into the substance of which it does not sink. The parapophysial surface for the head of the rib has risen in a small proportion upon the base of the neurapophysis, a trace of the sutural line of which crosses the costal articular surface, and defines the proportion supported by the centrum. Other vertebral characters of *Tapinocephalus* will be detailed in the specimen No. S. A. 5, the subject of Plate III., discovered in a different but not distant locality and in the same formation. The present bisected vertebra, with the above-described remains of the skull, is

From a triassic formation "four miles from Jan Willem's Fontein."
W. Guyton Atherstone, M.D. [P.].

No. S. A. 5. A centrum with the anchylosed base of the neural arch of a dorsal vertebra of *Tapinocephalus atherstonii*.

As in the preceding specimen, the fore surface (Plate III. fig. 1) as well as the hind surface deviates from flatness by only a slight concavity; and they are chiefly remarkable for the orifice, *c'*, of the biconical canal traversing the centre of the vertebral body lengthwise. The antero-posterior diameter of the centrum is two inches and a half, being but half the breadth of that part, which is five inches. The former diameter slightly increases towards the lower surface. This part is almost flat lengthwise, but becomes concave at the sides, the anterior and upper half of which is occupied by the articular surface (fig. 2, *p*) for the head of the rib. This surface is almost flat and slightly prominent. On the outer side of the base of the neurapophysis the low beginnings of a pair of buttress-ridges (fig. 2, *a*, *e'*) are seen converging towards the under surface of the diapophysis (fig. 1, *d*), here broken away. The fractured surface of the neurapophysis (fig. 3, *np*, *np*) exposes a close or fine cancellous texture. The neural canal (ib. *n*) is an inch in diameter at its narrowest (middle) part. A trace of the primitive neuro-central suture (fig. 1, *nc*) is visible on the anterior surface of this vertebra.

* Owen's 'Odontography,' 4to, 1840, p. 200. † *Op. cit.* p. 251.

phalus is transversely undulate, convex at the middle and concave at each side to a subtrenchant and

From triassic deposits at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 6. Two similar portions of dorsal vertebræ, with the parapophysis on the corresponding part of the side of the centrum, and with the same indications of the unossified tract along the middle of the centrum. In one of these vertebræ (S. A. 6′) the rise of the parapophysial surface upon the neurapophysis is shown, indicative of its more posterior position in the dorsal series.

From triassic deposits at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 7. The centrum and neural arch of a dorsal vertebra of *Tapinocephalus atherstonii*.

In this fossil the surface for the head of the rib has risen wholly upon the neurapophysis, and seems to have been contiguous to the diapophysial surface; but both surfaces have been abraded, and the compact or dense texture of the bone is there exposed. The dinosaurian expanse of the roof of the neural arch is here exemplified, and the backward extension is shown of the bases of the postzygapophyses. The concavity of the anterior surface of the centrum is somewhat increased; that of the posterior surface changes to convexity at its lower third, with general loss of size. The characteristic central aperture is conspicuous.

From a triassic formation at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 8. The centrum and anchylosed base of the neural arch of two hinder dorsal or lumbar vertebræ of *Tapinocephalus atherstonii*.

From a triassic deposit at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 9. The centrum and partially anchylosed neural arch of a lumbar or hinder dorsal vertebra of *Tapinocephalus atherstonii*: Plate IV.

The concavity of the articular ends of the centrum is somewhat greater than in S. A. 6. The orifice (Plate IV. fig. 1, *c*′) is repeated at the middle of each surface. The cavity so terminating indicates an arrest of ossification of the notochord (*chorda dorsalis*) at this part of the centrum. The parapophysis has disappeared, the head of the rib having risen to articulate with the neural arch, *np*. The side of the centrum (ib. fig. 2) is rather more hollowed beneath the base of that arch, *np*, but shows no partial excavation, as in *Bothriospondylus*. The sides of the centrum converge as they descend, and are continued by a more abrupt bend into the under surface (ib. fig. 3). This surface is also flatter than in the more anterior dorsals. It shows several small scattered orifices of, probably, venous canals. Where the natural superficies of the non-articular parts of the vertebra have been preserved, they present a smooth, some-

what glistening appearance. The proportions of length to breadth are nearly the same as in the preceding specimens; but both dimensions have somewhat decreased.

From a triassic deposit at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 10. Four of the coalesced sacral vertebræ, somewhat mutilated, of *Tapinocephalus atherstonii*: Plate V.

The anterior surface of the centrum of the foremost vertebra shows the characteristic central vacuity (ib. fig. 3, *c'*), here circular, two thirds of an inch in diameter, thus rather wider than in the dorso-lumbar series. The centrum has suffered fracture below this part. The under (hæmal) surface (ib. fig. 2) is longitudinally canaliculate, the channel being wide and moderately deep. It becomes shallower and somewhat narrower in the second sacral vertebra (*s* 2). This surface extends somewhat abruptly into the lateral surfaces, which are concave antero-posteriorly.

The confluent base of the first sacral rib (ib. *s*, *pl*) extends nearly to the under surface of the centrum. The next (*pl* 2) leaves rather more of the side exposed in the second sacral vertebra; and the whole of the side of the centrum is free from the rib-joint in the third and fourth. In these the sides of the centrum are more deeply concave from before backward, and the borders of the anchylosed centrums are more prominent. The fractured hinder surface of the fourth sacral permits the supposition that *Tapinocephalus* might have had five sacrals, as in *Iguanodon*, *Omosaurus*, and some other Dinosauria.

The confluence of the neural arches of the first and second sacrals in the present species is more extensive and complete than in the third and fourth sacrals, in which they seem to have risen directly from their respective centrums, and to have projected neurad, independently of each other. But they have here suffered considerable fracture.

From a triassic deposit at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 11. The mutilated centrum of two caudal vertebræ of *Tapinocephalus atherstonii*, one of which has been vertically bisected to show the central canal, indicative of the persistent unossified tract of the notochord.

Where, as in one half of this section, the exact mid line of the centrum is preserved, the canal presents the form of an hour-glass, the apices of the conical cavities (Plate V. fig. 4, *c'*, *c'*) intercommunicating at the middle of the centrum. Arrest of the centripetal ossification has thus left a moniliform canal along the vertebral column of *Tapinocephalus*; and a third modification of the vertebral bodies in the order Dinosauria is here exemplified.

From a triassic deposit at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

No. S. A. 12. Portion of a dorsal rib of *Tapinocephalus atherstonii*, showing the angle of junction of the "neck" with the "body."

The double articulation of the pleurapophysis with the rest of its vertebral segment, the complexity and expanse of the neural arch and platform, and the structure and extent of the sacrum show the rela-

tions of *Tapinocephalus* to the Dinosaurian order. The perforation, or unossified tract, of the centrum indicates a distinct and lower-organized, or less-advanced, family in that order. The skull, in its breadth and flatness, approaches the form most common in Labyrinthodontia; but the few vestiges of dentition demonstrate a closer affinity with the serratident Dinosaurs, and indicate the habits and diet of the extinct reptile to have been akin to those of the family and genus of South-African Reptilia next to be described.

From a triassic deposit at "Gats Plaatz, Spreuw Fontein, Prince-Albert District," Cape of Good Hope.

W. Guyton Atherstone, M.D. [P.].

Fam. SERRATIDENTIA.

Genus Pareiasaurus, Ow.

1. *Pareiasaurus serridens*, Ow.

No. S. A. 13. The skull, with some mutilation and distortion of the lower jaw (a coloured plaster-cast) : Plates VI. & VII.

In the year 1838 the constructor of the Queen's Road, Cape of Good Hope, A. G. Bain, Esq., while encamped on the "Blinkwater River," in the operations of carrying on the road through the forest up to the "Winterberg," discovered, in blasting rocks belonging geologically to the "Beaufort Beds of the Karoo series" (probably equivalents in time of the "Trias" or "Lower Lias" of Europe), the skull of "a huge animal with 56 fluted and serrated teeth"*.

The specimen having been sent to the Geological Society of London, I was permitted to take a cast of it (it is the subject of Plates VI. & VII.), and also to make the sections of the lower jaw (Nos. S. A. 14 & 15) figured in Plate VIII. figs. 1 & 2.

The teeth are close-set, implanted in an alveolar groove, bounded chiefly by an outer wall (Plate VIII. fig. 2, *a*), but with a low inner wall (ib. ib. *b*), and crossed by rudimental partitions. The germ of a successional tooth (ib. ib. *c*) was detected beneath, and on the inner side of the worn tooth in place (ib. ib. *d*), on exposure of the alveolar groove, as in fig. 2.

The teeth in this skull resemble those of the Iguanodon in their mode of implantation†, and those of the Scelidosaur in their close arrangement and nearly uniform wear‡. The crowns are not so much or so regularly overlapped as in the Iguanodon; but the degree of abrasion indicates, as in the Iguanodon, that they were applied to the mastication of vegetable substances§.

* See 'The Eastern Province Monthly Magazine,' 8vo, Graham's Town, Cape of Good Hope, 1856. Also the "Letter" by Mr. Bain, dated "Port Beaufort, April 29, 1844," published in the Seventh Volume of the Second Series of the 'Transactions of the Geological Society of London,' 4to, 1856, in which the author states:—"It was near the Blinkwater Post that, while superintending the construction of the road, I succeeded in extracting from the scarp of a steep hill of sandstone the lower part of the pelvis, a fragment of a bony cuirass, the head armed with sixty teeth, and other bones of a large reptile" (p. 56).

† Monographs on the Iguanodon, volumes of the Palæontographical Society, 4to: 1860, pl. vii.; 1873, pl. i. figs. 1 & 8.

‡ 'Monograph on the British Fossil Reptilia of the Liassic Formations, *Scelidosaurus*,' vol. of the Pal. Soc., 4to, 1861, pls. iv., v., vi.

§ In the same formation as that which included remains of *Pareiasaurus*, Mr. Bain remarks, "whole forests of calcified trees, of large size, are found in the neighbourhood of Sunday and Bushman's Rivers, in a most perfect state of preservation, imbedded horizontally in the rock. Ferns, zamias, and fragments of wood in a lignitic state occur, mixed up with fragments of gypsum and reptilian bones, together with marine exuviæ—*Trigonia*, Ammonites, and various other mollusks." ('Transactions of the Geological Society,' 2nd series, 4to, 1856, vol. vii. p. 184.)

2. *Pareiasaurus bombidens*, Ow.

The reptilian nature of the fossil animal being inferred from the provision for continuous replacement of these teeth, its affinity to the order including the great extinct phytophagous saurian of the European Wealden is deducible from the other above-defined dental characters.

The upper teeth have not the outer longitudinal ridges, and the lower teeth have not the inner ones, characteristic of those of the Iguanodon; their crowns are likewise devoid of the single median ridge of the Scelidosaurian teeth; but, as in both these Dinosaurs, the margins of the crown are notched or serrate.

Cranial characters concur with dental ones in supporting the formation of a family in the Dinosaurian order for the South-African reptiles, of which the generic distinction of the fossil described is expressed by the term *Pareiasaurus**, in reference to the depth and breadth of the zygomatic arch. The species of this genus represented by the skull figured in Plates VI. & VII. is the *Pereiasaurus serridens*, Ow.

The length of the skull is 1 foot 6 inches; the breadth across the zygomatic processes is 1 foot; the depth at the same processes is 11 inches; the extent of the dentigerous border of the mandible is 8 inches. The fossil is reduced to two thirds the natural size in Plates VI. & VII. The depth or vertical extent of the mandible at the middle of the dental series is 3 inches 9 lines, and increases as the ramus recedes; it is shown of the natural size in Plate VIII. figs. 1 & 2.

The cranium has been obliquely distorted by pressure. The remains of the single occipital condyle are discernible at the occiput, the plane of which is triangular and subvertical. The temporal fossæ have a minor longitudinal or antero-posterior extent than in most carnivorous Saurians: their proportions resemble those in the Iguanodon† and Scelidosaur‡. The orbit (Plates VI. & VII., *o*) is circular, and opens midway between the fore and hind ends of the cranium; it is relatively smaller than in the Scelidosaur §, and more so than in the small or young Iguanodon‖: the facial part of the skull is more prolonged in both these European Dinosaurs than in *Pareiasaurus*. The mastoid is a massive bone; and from its chief part or body, forming the upper and hinder angle of the cranium, it sends a process inward to join the parietal, a second process forward to join the postfrontal and overbridge the temporal depression, and a third downwards to fix by an extended suture the tympanic. This bone, after forming the joint for the lower jaw, combines with the broad descending zygomatic plate (Plates VI. & VII., *z*), to which it gives strength as a buttress. The plate itself, formed by the combined malar and squamosal, descends to the level of the lower margin of the mandible, terminating there in a moderately thick, roughly rounded border; the antero-posterior extent is $4\frac{1}{2}$ inches, and increases as it rises to its origin from the normal zygomatic arch, of which the malar element (*ib.* 26) unites anteriorly with a large lacrymal (*ib.* 73). From the débris of the lacrymal and malar in the small or young Iguanodon¶, a like production of the zygomatic arch may be inferred, though possibly less developed. The descending plate is present in *Anthodon*, and is preserved on both sides of the skull of the unique example of *Scelidosaurus* now in the British Museum**; but it is inferior in relative depth and breadth to that in *Pareiasaurus*. This cranial feature is not present in any existing Saurian, and is peculiar, according to present knowledge, to the above members of the Dinosaurian order among extinct Reptilia. The nostril in *Pareiasaurus* appears, in the somewhat mutilated fore part of the subject of Plates VI. & VII., to be single with a forward aspect. The dentigerous border of the premaxillary is entire; and that seemingly single bone rises, with a moderate curve, convex forward (*ib.* 22), three inches before attaining the lower border of the nostril. But little, therefore, seems to be wanting, and any naso-premaxillary vertical bridge bisecting the actual single orifice must have been narrow. The fore end of the skull, beneath the external nostril, was broadly and transversely convex in *Pareiasaurus bombidens* (Plate IV. fig. 3, 22). From the oblique crush of the fossil skull of *Par. serridens* the whole aperture of the nostril, *n*, is seen in the right-side view (Plate VI.), but only the outer border of the aperture in the left-side view (Plate VII.).

The lower jaw presents the reptilian composite structure; in the section figured (Plate VII. fig. 2) is shown the "dentary" element, 32, the thin "splenial," 31, and the stout "angular," 30, underlapping the

* Gr. *παρειά*, cheek, or cheek-piece of a helmet; *σαῦρος*, lizard.

† Monogr. cit. (1873), pl. i. fig. 9.

‡ Monogr. 1861, pl. vi. fig. 1.

§ Monogr. 1861, pls. iv. & v., *o*.

‖ Monogr. 1873, pl. i. fig. 9, *o*.

¶ Monogr. 1873, pl. i. fig. 9, 23, 73.

** Monogr. 1861, pls. iv. & v. 26, 27, 73.

tions of *Tapinocephalus* to the Dinosaurian order. The perforation, or unossified tract, of the centrum [illegible] lower organized, or less-advanced, family in that order. The skull, in its breadth

wide vacuity which these several elements enclose. The rami of the mandible are confluent anteriorly at a short and deep symphysis, the fore part of which descends almost vertically, with a slight convex contour, to the lower border, the depth being 3 inches. The antero-posterior extent of the symphysis is barely 2 inches. The breadth of the mandible at the hinder border of the symphysis is 4 inches. The outer breadth of the mandible at the hind ends of the divergent rami is 8 inches. The angle of convergence of the rami to the symphysis is such as to show that the mandibular teeth might be overlapped by the maxillary ones when the mouth was close shut. The dentigerous portion of each ramus is compressed, but deep (Plate VIII. figs. 1 & 2). The lower border descends and gains thickness beyond the dentigerous part, the depth of the ramus there being 5 inches. Fifteen or sixteen teeth are close-set on each side of both upper and under jaws, the lateral series in each meeting at the mid line in a continuous convex curve. As in man there is no diastema in the dental series, no one tooth is longer than the rest. But there is still greater uniformity in the teeth of this ancient Saurian. Not any would be characterized by the shape of the crown as incisors, or canines, or as false or true molars; the fore-and-aft diameter of the crown of the hindmost hardly, if at all, exceeds that of the foremost teeth; each of them shows by its abraded border that it has taken a share in the pounding as well as cropping of the vegetable food.

The provision for the temporal muscles is small, as in Ruminants; and concomitantly with the greater amount of rotatory motion of the under jaw in the chewing than of vertical motion in the biting movements is the development of the part of the skull affording origins or fixed points to the masticatory muscles (masseters and pterygoideans). This is exemplified in the descending plate or process of the zygomatic arch. And it is interesting to find that the homologous descending process occurs only in those phytophagous mammals which, in the low development of the brain, come nearest to the Reptiles, viz. in the lyencephalous Kangaroos * and the lissencephalous Sloths and Megatherioids †.

From the triassic formation ‡ at Blinkwater, Cape of Good Hope.
Professor Owen, C.B., F.R.S. [P.].

No. S. A. 14. Section of a right mandibular ramus of *Pareiasaurus serridens*, Ow., showing a successional tooth in the alveolar groove and three teeth "in place," of the crowns of which a transverse section has been made.

From the triassic formation at Blinkwater, Cape of Good Hope.
A. G. Bain, Esq., F.G.S. [P.].

No. S. A. 15. Section of a right mandibular ramus of *Pareiasaurus serridens*, Ow., showing a successional tooth and the tooth "in place" which it was about to succeed; both teeth are shown in longitudinal section.

The thin crust of enamel and dentine enclosing the large cavity which contained the pulp or matrix of the young tooth has yielded to pressure on the inner and undefended side of the alveolar groove. The coronal enamel of the fully formed teeth is finely grooved lengthwise near the base of the crown, but is smooth upon the broader body of the tooth, which is moderately convex; indications of the marginal serrations may be seen.

The above two specimens are the subjects of figures 1 and 2, Plate VIII.: fig. 1 was taken before the transverse section and the second longitudinal section were made. In figure 2 the "dentary element" is marked 32, the high and thick outer alveolar wall is lettered *a*, the low and thin inner alveolar wall *b*; the "angular element" is marked 30, the "splenial element" 31.

From the triassic formation at Blinkwater, Cape of Good Hope.
A. G. Bain, Esq., F.G.S. [P.].

* Trans. Zool. Soc. vol. ix. pl. lxxiv. fig. 1. 21* (*Macropus rufus*).
† Owen, 'Description of a Gigantic Extinct Sloth (*Mylodon robustus*),' 4to, 1842, pl. ii.
‡ See Mr. Bain's remark, Trans. Geol. Soc. *tom. cit.* p. 190.

2. *Pareiasaurus bombidens*, Ow.

No. S. A. 16. This species is represented by a portion of the fore part of the skull, including a certain extent of the alveolar border and teeth of both upper and lower jaws. Eight anterior teeth, more or less mutilated, are exposed in the right upper jaw, and the foremost tooth of the left side; the remainder on this side are overlapped and more or less concealed by the slightly displaced alveolar plate and teeth of the left ramus of the lower jaw.

A side view of this specimen is given, of the natural size, in Plate IX., and a front view in Plate VIII. fig. 3. The transverse or horizontal contour of the fore part of the lower jaw is indicated by the line 3 *a* in Plate VIII.

The premaxillary ascends from the anterior alveoli toward the nostril, with a slight inclination forward from the vertical line (Plate VIII. 22). About two inches of this part of the jaw is preserved; but the fracture has taken place before the nostril was reached.

The eight anterior upper teeth of the right side occupy an extent of 5 inches. The crown of the right foremost tooth (Plate VIII. fig. 3, 1) inclines as it descends toward its fellow (1′) of the left side, leaving an intervening portion of the alveolar symphysial plate of a triangular form.

The preserved portion of the left mandibular ramus (Plate IX. 32) contains nineteen teeth; they are close-set, of equal length, as in the genus, with slight indications of different, subalternate periods of rise, but with no iguanodontal intervals. The last-erupted teeth are indicated by the preservation of the terminal serrations of the coronal margin. These serrations are broader, and some of the linear intervals extend nearer to the base of the crown, than in the teeth of *Pareiasaurus serridens*. But a better-marked specific distinction is shown by the more convex or bulging outer surface of the crown of the mandibular teeth in the subject of Plate IX., which suggested the "nomen triviale." Supposing the number of the teeth to be correctly given in *Pareiasaurus serridens* (in which fourteen on each side of both jaws were counted in the skull when first discovered, making a total of fifty-six, as recorded in the 'Colonial Magazine,' quoted p. 6), the number of teeth is greater in the present species; and, concluding from the marks of abrasion that each maxillary tooth was opposed by a mandibular one, the *Pereiasaurus bombidens* must have had seventy-six fluted and serrated teeth.

From the triassic formation at "Vers Fontein," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 17. A cervical vertebra of *Pareiasaurus bombidens*.

This vertebra is shown to have come from an anterior region of the spinal column by the width of the neural canal (Plate X. fig. 5, *n*) and by the presence of both par- (ib. figs. 1, 3, 4, *p*) and di- (ib. figs. 1–5, *d*) apophyses for the capitular and tubercular articular surfaces of the ribs. But there is an oblique subtriangular facet (ib. figs. 1, 3, 5, *hy*), cut off, as it were, from the middle of the fore border of the under surface of the centrum, rough for syndesmotic attachment to a hypapophysis, answering to those at the fore part of the neck in the Plesiosaurs and Ichthyosaurs; and by this character it may be inferred that, if the present vertebra were not the foremost of the cervical series, it would be the second or, at most, the third.

The centrum is deeply cupped at both ends, the borders of the cavity thick and convex, with linear concentric lines indicative of ligamentous attachment; a low subtriangular rising (ib. figs. 1 & 3, *c*′) of the surface descends from the upper border to near the middle of the concavity. Here occurs the basal aperture of the abrupt small conical cavity, the apex of which is separated by 1 line thickness of bone from that of the opposite hollow cone. The tretospondylian character of *Pareiasaurus*, however, is sufficiently demonstrated by bisection of the centrum, though ossification of that part has proceeded further in the present genus than in *Tapinocephalus*.

The parapophysis (*p*) is low and rather small near the fore border at the lower half of the centrum; the larger diapophysis (*d*) projects from the same position of the upper half, and may have been developed from the neurapophysial base there descending. The "laminæ" (*np*) rise clear of the outstanding process; the end of this has been broken across in both diapophyses.

The rough margin of the hypapophysial surface extends from the parapophysis downward and backward to the truncated apex of that surface. This, at first sight, suggests a character of a caudal vertebra; but the capacity of the myelonal canal and the lateral position of the processes supporting the head and tubercle of the rib, weigh down the scale in favour of the inferior subtriangular oblique rough surface (fig. 4, *hy*) having contributed to the attachment of a subcervical "wedge-bone" or hypapophysis.

From the triassic formation at "Vers Fontein," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 18. Centrum and neural arch, wanting the spine, of a dorsal vertebra of *Pareiasaurus bombidens*.

The concavity of the articular surfaces (Plate XI. fig. 2, *c*) of the centrum is much reduced in both extent and depth; and the vertical and transverse diameters are subequal. The tretospondylian character is demonstrated by a section of the vertebra. The parapophysis (ib. fig. 1, *p*) has subsided to near the level of the side of the centrum, and has risen in position to near the base of the neurapophysis (ib. fig. 1, *np*). This rises to half the height of the centrum; and the sides show the two buttress-like ridges (ib. fig. 1, *a*, *e*) rising and converging to the base of the diapophysis (ib. *d*). On the remains of the neural platform may be traced the bases of the præzygapophyses (ib. *z*) and of the neural spine (ib. *ns*). The postzygapophyses (fig. 2, *z'*, *z'*) are sections, as it were, of the hind part of the platform, converging downward, and with their flat surfaces turned downward and outward. The indications of the neural canal (ib. *n*) give some diminution of its area as compared with that in the more advanced part of the spine indicated by the vertebra No. S. A. 17. The unossified conical tracts have the apices separated by a greater extent of osseous texture than in *Tapinocephalus* (Plate XI. *c'*, *c''*).

From the triassic formation at "Vers Fontein," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 19. A vertebra from the hinder part of the dorsal, or from the lumbar, region of a *Pareiasaurus*.

Both articular surfaces of the centrum are nearly flat: the anterior one shows a feeble convexity towards the periphery; a greater proportion of the posterior surface is slightly concave. The non-articular surface is feebly concave lengthwise, and also vertically at the upper part of the side. The surface for the head of the rib occupies the whole fore-and-aft extent of the base of the neurapophysis. From the lower border of this surface to the upper one of the diapophysis measures 3 inches 4 lines, the total height of the vertebra being 10 inches. The extreme breadth of the centrum is 4 inches 9 lines: that of the neural platform would be greater; but both diapophyses have suffered fracture. The præzygapophyses look upward and inward; the postzygapophyses, springing from a higher level, have opposite aspects. The neural spine, 4 inches in length, is thickest antero-posteriorly at its base, but expands to a greater transverse diameter at its summit, as in *Omosaurus*. The neural canal is comparatively small.

From a triassic deposit at "Jan Willem's Farm," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 26. A portion of the right ilium, including parts of the antacetabular and

No. S. A. 20. The centrum and base of the neural arch of a caudal vertebra of a *Pareiasaurus*.

The par- and di-apophyses are in contact, indicative of absence of bifurcation of the vertebral end of the pleurapophysis, which may have been confluent as a "transverse process," the supporting parts having suffered fracture. The proportions of length to breadth of the centrum do not differ from those of the foregoing vertebra more than is usual in the different parts of the column to which they belong. The hæmapophysial surfaces are indicated on both fore and hind margins of the under (hæmal) part of the centrum.

From a triassic formation at "Jan Willem's Farm," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 21. The centrum and base of the neural arch of four hinder caudal vertebræ, progressively decreasing in size; in the last and smallest the vertical dimension of the centrum predominates, indicating a compressed natatorial form of the end of the tail.

From a triassic formation at "Jan Willem's Farm," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 22. The coalesced humeral ends of the right scapula and coracoid of *Pareiasaurus bombidens*.

The line of original synchondrosis is traceable on the articular ('glenoid') cavity. This is of an elongate suboval form, moderately concave in its long diameter, which measures in a straight line $8\frac{1}{2}$ inches; its greatest breadth (on the coracoid bone) is $4\frac{1}{2}$ inches.

From a triassic deposit at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 23. The right humerus of *Pareiasaurus bombidens*.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope.
W. Guyton Atherstone, M.D. [P.].

No. S. A. 24. The left humerus of the same individual (*Pareiasaurus bombidens*, Plate XII.).

Each humerus has a length of 1 foot 7 inches; the extreme breadth of the bone is 1 foot $1\frac{1}{2}$ inch; the breadth of the distal surface is 1 foot; the least circumference is 1 foot 3 inches.

The shaft giving the last dimension (ib. fig. 5) is a mere constriction of the bone between the proximal (b')* and distal (e) expansions; the humerus seems as if it had been twisted at that point nearly half round upon its axis. The proportion of breadth to length, which is noted as remarkable in the description of the Dinosaurian humerus of the British extinct reptile referred to the genus and species

* In the above description the end of the bone next the body or scapular joint is "proximal," the opposite end "distal;" the side toward which the elbow (ancon) projects is "anconal," the opposite side "thenal;" the border next to which the ulna joins the humerus is "ulnar," the opposite border "radial."

*Omosaurus armatus**, is exaggerated in the present South-African Dinosaur to the extent characteristic of the humerus of the mole. The proximal articular surface (ib. fig. 3) is of an elongate semioval figure, 8 inches in long diameter, 4 inches across its broadest part; the straight side is toward the thenal surface; the convex side is formed by an extension of the joint *a* toward the anconal surface of the bone; the larger end of the semioval "head" is towards the ulnar border; but the homologue of the ulnar tuberosity, *c*, extends 3 inches beyond that end of the "head" or articular convexity of the humerus. The radial tuberosity, *b*, appears as a continuation of the smaller end of the proximal articular surface, at first radiad or outward, then distad or downward two thirds of the way to the distal end; here the thick strong (delto-pectoral) plate, *b b'*, returns, forming a right angle to the short shaft. This is subtrihedral in section (fig. 5). A slight prominence at its fore or thenal surface extends obliquely to the ulnar (ectepicondylar) tuberosity, *f*. The radio-distal crest, *e*, answering to the "supinator-ridge" in the mammalian humerus, begins near the anconal side of the short shaft on the transverse level of the subsidence of the delto-pectoral crest; it extends 3 inches radiad, then bends down at an obtuse angle, gaining thickness and being lost in the entepicondylar tuberosity, *e'*. The plane of the expanded distal part of the humerus looks nearly at right angles to the plane of the thenal surface of the proximal two thirds of the shaft. This plane (between *b*, *b'*, *c*), subquadrate in form, is slightly concave. On the opposite, anconal surface (fig. 2) the proximal half is correspondingly convex transversely, with a slight undulation caused by a rising of the part of the surface leading from the ento-tuberosity toward the shaft. This does not develop a longitudinal tuberous rising like that in the humerus of *Omosaurus*†; the rising, *d*, in fig. 2, begins nearer the articular head of the humerus in *Pareiasaurus*. The shaft is solid throughout; a close osseous texture occupies the thin compact wall. At the distal end the radial condyle, *g*, forms the chief part of the articular surface; it not only projects further thenad, or forwards, than the ulnar condyle, *f*, but it is more extended transversely than in the Monitor Lizard, and it is more feebly and more uniformly convex. Toward the anconal aspect it becomes slightly concave transversely; and it is divided by an ancono-thenal rising from the ulnar articular surface, which can hardly be called a condyle, inasmuch as it is very feebly convex from before backward and is rather more concave from side to side, indicative of its usual trochlear character. The transverse (radio-ulnar) breadth of the ulnar surface is but half that of the radial surface. Both surfaces are impressed with round holes or pits scattered at irregular distances, rarely exceeding half an inch, with smooth intervening tracts—indicative, as in the articular end of Enaliosaurian humeri, of chondroso-ligamentous junction with the contiguous bones.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

No. S. A. 25. The right ulna of *Pareiasaurus bombidens*.

This bone corresponds, in the proportions of breadth and thickness to length, with the humerus. The length is 1 foot 1 inch; the extreme breadth 9 inches; the least circumference of the shaft is 10 inches. The shaft here, near the slight distal expansion, is subcompressed, and gives in transverse section a three-sided figure; the side next the radius is 5 inches in breadth; the other two sides are $3\frac{1}{2}$ inches and 3 inches respectively. There is no medullary cavity. The olecranon is a low tuberosity; above the humeral articular surface the transverse convexity corresponds in degree with the concavity of the ulnar surface of the humerus. The articular surface for the side of the head of the radius is concave, chiefly so in the transverse direction.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

* 'Monograph on the Mesozoic Fossil Reptilia of Great Britain,' volume of the Palæontographical Society, issued 1875, pl. xvii. figs. 1–5.

† Monogr. cit. plate xvii. fig. 2, *d*.

No. S. A. 26. A portion of the right ilium, including parts of the antacetabular and postacetabular productions, the base of the thick intermuscular ridge upon the antacetabular production, and the iliac part of the acetabulum, of *Pareiasaurus bombidens*.

The non-articular iliac border of the acetabulum shows two notches, apparently for the passage of vessels into the joint. The articular border is divided into two synchondrosal surfaces, apparently for both ischium and pubis.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

No. S. A. 27. A portion of the left ilium, somewhat more mutilated, of the same individual *Pareiasaurus bombidens*.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

No. S. A. 28. The proximal portion of the right femur of *Pareiasaurus bombidens*.

The articular surface is continued from the subhemispherical head of the bone along the surface, extending outward and sloping somewhat distad to the summit of the "great trochanter." There is no constriction or neck. From the fore part of the head a low broad rising extends distad upon the middle of the anterior surface of the shaft, dividing that surface into two facets. The proximal expansion of the femur is, anteriorly, slightly concave through the above prominence. The hinder surface of the proximal expansion is more deeply concave across; and at its lower part projects a process which might be called a "small trochanter." The hinder surface of the shaft is almost flat.

As in the humerus, there is no medullary cavity; the compact wall of the bone encloses a dense or fine cancellous structure. The breadth of the proximal end is 10 inches; that of the shaft a little above the fracture is $4\frac{1}{2}$ inches; at the fracture the bone has expanded to a breadth of 5 inches, from which it may be inferred to have been short in proportion to its breadth and thickness.

From a triassic formation at "Vers Fontein, Mr. Luttig's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

No. S. A. 29. The right tibia of *Pareiasaurus bombidens*.

The proportions of this bone support the inference of the shortness and thickness of the hind limb, from so much as has been preserved of the femur.

The length of the tibia is 11 inches; the extreme breadth at the proximal end is $7\frac{1}{3}$ inches, at the distal end 6 inches; the least circumference of the shaft is 1 foot.

The malleolar part of the distal articulation is convex, like a ball, passing into a flatter articular surface on the fibular half of that end of the bone. A bituberculate prominence from the middle of the back part of the shaft appears to be natural.

From a triassic formation at "Jan Willem's Farm," Cape of Good Hope. W. Guyton Atherstone, M.D. [P.].

Genus Anthodon*, Ow.

In this genus of Dinosauria the teeth have the family characters of the Serratidentia being serial, close-set, equal-sized, and with marginally notched crowns; but they differ generically from those of *Pareiasaurus* in having the crowns more compressed transversely, and more expanded antero-posteriorly beyond the roots, which are relatively longer and more deeply implanted in the jaw; the crown terminates in a semicircular border, deeply notched, rather crenate than serrate, somewhat resembling a polypetalous flower supported on a thick stem, whence the name proposed for the genus.

Species *Anthodon serrarius*, Ow.

No. S. A. 30. The skull, somewhat crushed and mutilated, wanting both ends.

If this portion of skull (which is figured, of the natural size, in Plate XIII.) be from a full-grown or mature individual of the species, it represents a phytophagous reptile of about half the size of the two known kinds of *Pareiasaurus*, and may have been adapted to browse on plants of a more delicate texture.

The portion includes the middle half, or rather more, of the skull, but so fractured as to show chiefly the left side; and of this much of the surface has been removed together with the matrix.

On this side may be determined the subcircular orbit (ib. *o*), the temporal fossa (ib. *t*), a great proportion of the zygoma with a large descending or masseteric plate, *z*, and a portion of the left mandibular ramus, 31-32, corresponding in extent with the cranium above.

Five maxillary teeth and part of a sixth tooth are exposed anterior to the masseteric plate. The hind border of the crown overlaps the fore border of the tooth behind. Each tooth is implanted by a single root of twice the length of the crown. The lower jaw and teeth pass, the mouth being closed, within the upper, by which they are then concealed. The removal of part of the maxilla and teeth anterior to those in place has brought into view the crowns of two mandibular teeth of similar shape and size.

The present skull of *Anthodon serrarius* is about the same size as that of *Scelidosaurus harrisonii*†; but the teeth of *Anthodon* were fewer and larger, nearly twice the size of those of the Dinosaur of the British Lias. A difference of vegetable food may have been related to this difference of dentition, the general form and serrate character being the same.

From a mesozoic formation at "Bushman's River, halfway between Graham's Town and Port Elizabeth, in a marine formation containing teeth of fish, liassic shells, and fossil trees in great quantity."—*Note by the donor.*

Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 31. Counterparts of a split mass of matrix, exposing a portion of the left mandible and teeth of *Anthodon serrarius*. This specimen is drawn in outline in Plate XIII. fig. 2, and finished, of twice the natural size, in fig. 3.

Of the four serial teeth in place, showing the outer side of the crown, the one most abraded, *b*, has part of the root exposed. An adjoining tooth, *a*, shows the entire crown. This has a "cingulum," or smooth swollen border, along its base; above this the surface is impressed by vertical grooves terminating in the marginal notches, defining five or six smaller serrations on each side of a median larger one which forms the summit of the unworn border of the crown. The grooves from this division define, as they descend to the cingulum, a vertical tract of enamel more prominent than the narrower ones on each side.

* Gr. ἄνθος, flower; ὀδούς, tooth.

† Monograph (*Scelidosaurus*) 1861, t. iv.

The dental formula of the genus *Lycosaurus* appears to have been:—

The cingulum makes a slight curve convex towards the fang on each side of the mid tract. Portions of two other serial teeth, *c*, *d*, are preserved in this fragment (figs. 2 & 3); also the crowns of two successional teeth, *e*, *f*, beneath those, *b*, *d*, in place. Part of the germ of another crown is exposed at a lower level in the jaw at *g*. In figure 4 is shown the inner side of a mandibular tooth, with a longitudinal section of the root exposing the pulp-cavity. In the absence of the prominent mid tract of the crown the inner surface resembles the outer one of the maxillary teeth; and, reciprocally, the inner surface of the crown in the maxillary teeth most probably presented modifications corresponding to those of the outer surface of the crown of the mandibular teeth, against which such surface worked, in the relative (overlapping) position of the upper and lower jaws of the present Dinosaurian reptile.

From a marine (liassic?) formation at "Bushman's River," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 31*. Portions of matrix with fragments and impressions of bones of *Anthodon serrarius*. The matrix consists of a highly calcareous sandstone.

From a marine (liassic?) formation at "Bushman's River," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Order THERIODONTIA †.

Char. Dentition of the carnivorous type; incisors defined by position, and divided from molars by a large laniariform canine on each side of both upper and lower jaws, the lower canine crossing in front of the upper as in Mammalia.

Section BINARIALIA.

In this Section the external nostrils are divided by a narrow partition; the entire skull has a compressed form.

Genus Lycosaurus ‡, Ow.

Species *Lycosaurus pardalis*, Ow.

No. S. A. 32. A mutilated skull, somewhat crushed laterally and obliquely, with much of the outer surface of the bones and teeth abraded. It is figured of the natural size in Plate XIV.

The portion of bone removed from the right premaxillary exposes part of the root and of the crown of three close-set incisors (fig. 1, *i*). The root of the anterior one extends close to the floor of the right nostril (ib. *n*); the root of the second incisor and that of the third incisor appear to be shorter, or less of such root has been preserved. The dentine is compact. The interspace between the incisors

† Gr. *θηρίον*, wild beast; *ὀδούς*, tooth; in reference to the resemblance of the Reptiles of the present order in their dentition to the class Mammalia.

‡ Gr. *λύκος*, wolf; *σαῦρος*, lizard.

Genus Anthodon*, Ow.

and the canine (ib. *c*) is slightly depressed for the reception of the crown of the lower canine, of which the summit appears at *c'*. The upper canine of the right side (ib. *c*) has been so much and so obliquely broken away that what remains ends in a point above, and is broadly rounded below; but this seeming base overlaps the alveolar border of the mandible, is solid, of the same compact dentine as the incisors, while the reduced pulp-cavity extends above this to the upper pointed end of the remnant of a deeply inserted base or root of an upper canine of limited period of growth. Behind this canine are the roots or bases of four succeeding teeth ("molars" by position, fig. 1, *m*) about the size of the incisors; the long root of the foremost extends parallel and close to that of the canine. The rest appear to have had the same simple, single-rooted implantation, and as simple a crown, though shorter in proportion to its breadth.

The mandible shows a deep symphysis, 32, expanding as it rises to an incisive alveolar border about 1 inch in extent, adapted to contain six incisors of the same size as the premaxillary ones above, by which they are concealed, the fore part of the lower jaw being overhung or overlapped by the upper jaw. The alveolar border presents a slight convexity at the outlet of the alveolus of the canine, the crown of which rises nearly to the level of the exposed part of the base of the upper canine. The enamel is striated by minute but well-defined lines. Beyond the socket of the lower canine the alveolar part of the mandible is depressed to receive the crown of the upper canine. The better-preserved portion of the left upper canine (fig. 2, *c*) confirms the interpretation of the remnant of that on the right side. The enamel is thin, but shows the fine well-marked lineation under a low magnifying-power; the hinder trenchant border of the crown shows a minutely festooned serration (ib. fig. 4). The preserved crown of one of the small molars of the left side shows its simple pointed form, according with the carnivorous character of the rest of the dentition.

The transverse contour of the symphysial end of the mandible appears to give the natural breadth of that part; and the compressed form of the fore part of the skull (as shown in figure 3 of Plate XIV.) must be nearly that of the original when imbedded.

The nostrils are terminal, with a septum 2 lines in least breadth (*s*, fig. 3). The position of the orbit is traceable on the left side of the skull (fig. 2, *o*), where the distance from the hind border of the nostril to the fore border of the orbit is 2 inches 6 lines. The extent of the skull broken away behind the orbit may be estimated to be such as would yield a length for the entire skull of *Lycosaurus pardalis* of 6 inches, or about the size of that of a Leopard, with the canines of which carnivore those of the present Saurian correspond in size, with apparently increase of length of crown in those of the upper jaw; but they have a lethal character superadded in the hinder trenchant and finely serrate border (see the magnified view, fig. 4, Plate XIV.).

The dentary element of the mandible loses depth as it recedes from the symphysis, and regains that dimension at its hinder bifurcation. Of this the upper branch is preserved (fig. 2, 32); and the depth of the ramus at the fractured hind extremity is 2 inches.

In a *Monitor niloticus*, with a mandibular ramus 5 inches long, the dentary element is 2 inches 9 lines in length. Taking the dentary, 32, of *Lycosaurus* to be two thirds the length of the jaw, this may be estimated at 6 inches 6 lines; it probably, as in the Monitor Lizard, extended a little further back than the paroccipitals.

From a triassic rock in the Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 33. A portion of the outer side of the right maxilla with teeth, apparently split off the skull No. S. A. 32.

It includes part of the outer wall of the crown of the canine, including a minute bit of the posterior crenate edge. This is followed by similar portions of the crowns of small conical teeth (Plate XIV. fig. 5). The alveolar border extends more than an inch beyond the four molars, without trace of an additional tooth.

The dental formula of the genus *Lycosaurus* appears to have been:—

$$\text{I.}\frac{3—3}{3—3'}\ \text{C.}\frac{1—1}{1—1'}\ \text{M.}\frac{5—5}{5—5'}=36.$$

The disposition, proportions, and shape of the above teeth indicate the present species to have been an eminently carnivorous reptile.

Species *Lycosaurus tigrinus*, Ow.

No. S. A. 34. A portion of skull, including the fore part of the upper and lower jaws, with the lower halves of the external nostrils. This specimen is the subject of Plate XV.

A great part of the crown of the right upper canine (fig. 1, *c*) is preserved; a portion of its finely crenate or serrate hind border is shown, as magnified, in figure 5; this closely resembles the same part of the teeth in our English oolitic *Megalosaurus*; but the proportions of the upper canines, and their limited number and position, are those in *Machairodus*, in which extinct mammalian carnivore the hind border of the canine is similarly serrate. The crown of the canine of *Lycosaurus tigrinus* would have reached the lower border of the mandible when the mouth was shut. Six molars are traceable in the alveolar part of the upper jaw behind the canine; all are more or less fractured, but leave indications of the simple conical form of crown as in *Lycosaurus pardalis*.

On the left side of this fossil the base of the upper canine (fig. 2, *c*) and the crown of the smaller lower canine (*c'*) are instructively shown. The symphysis mandibulæ, though deep, is short (fig. 4, *s*).

From a triassic rock at Mildenhalls, Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Genus Tigrisuchus*, Ow.

Species *Tigrisuchus simus*, Ow.

No. S. A. 35. Cast of the fore end of the upper jaw. The original specimen is figured, of the natural size, in Plate XVI. figs. 6–9.

The nostrils, *n*, *n*, are divided by a narrow septum, along which a median suture may be traced (as in fig. 8); the incisors (ib. *i* 1, 2, 3) are three in number in each premaxillary. The roots alone of these teeth are preserved; they are compressed where fractured (fig. 9), with narrow intervals which may have been filled by more expanded crowns. They increase slightly in breadth from the first to the third. This incisor is divided by a wider interval from the canine, *c*, of which tooth part of the base is exposed in the socket. The dentine of each of these teeth is of the simple compact kind.

From a triassic rock in the Sneewberg mountain-range, South Africa.

The original, transmitted for the above determination and description, is in the Museum at Albany, Cape of Good Hope.

Fam. MONONARIALIA.

In this family of Theriodontia the external nostril is single or undivided, and the incisors exceed three in number in each premaxillary.

* Gr. *τίγρις*, tiger; *σοῦχος*, crocodile.

Genus Cynodracon*, Ow.

Species *Cynodracon serridens.*

No. S. A. 36. The fore end of the skull, including the nostril and the series (more or less broken) of the upper incisors, with part of the base of a canine. The attached portion of the symphysis mandibulæ includes parts of incisors and canines.

This specimen is figured in Plate XVII.

The same overlapping relation of the upper to the lower jaw is shown as in *Lycosaurus*. The median pair of upper incisors (figs. 2 & 3, *i* 1) have their implanted ends half an inch apart; the roots converge as they descend and bring the crowns into contact. The crown is conical, with two postero-lateral finely serrate ridges or borders (fig. 7). The crowns of the third and fourth incisors slightly increase in fore-and-aft breadth; and the hind serrate border projects a little beyond the flat part of the outer surface of the crown. The sockets and fang of a fifth incisor (figs. 1, 4, *i* 5) are preserved, with the impression of the base of the crown.

Beyond the fifth alveolus the outer wall of the jaw sinks in a little, and a slight concavity intervenes between the incisive part of the upper jaw and the anterior swelling of the socket of the canine. The extent of the diastema here preserved is 1 inch 6 lines. The incisors are ranged in a semicircle. The external nostril (fig. 3, *n*) is transversely subelliptic, and opens just above the incisive alveoli. The fractured crowns of two of the lower incisors in the mandibular fragment are shown in fig. 4, *i*'. Similar evidences of the lower canines are shown at *c*, *c*.

From a triassic rock at Bovey's Farm, Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 37. A more mutilated fragment of the fore end of the skull of *Cynodracon serridens*, showing a greater proportion of the socket of the canine (Plate XVII. fig. 5) than in the preceding specimen. Sufficient of the roof of the skull formed by the nasal bone is preserved to show the shape of the aperture of the nostril, somewhat accidentally depressed (ib. fig. 8, *n*, *n*).

From a triassic rock at Styltcrantz, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 38. A symphysial portion of the mandible of *Cynodracon serridens*, with the implanted roots of the eight incisors and of the two canines. This specimen is represented of the natural size in figures 9 and 10, Plate XVII.

From the foregoing specimens the incisive and canine parts of the dental formula of the genus *Cynodracon* may be given as

$$\text{I.}\ \frac{5—5}{4—4},\ \text{C.}\ \frac{1—1}{1—1},\ \text{M.?}$$

From a triassic rock at Bovey's Farm, Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

* Gr. *κύων*, dog; *δράκων*, dragon.

upper jaw pierced by the nostril is slightly expanded as in the Teleosaur, in a less degree than in the Gavial. The nasal bones lose breadth as they recede from the nostril (15, fig. 1).

Species *Cynodracon major*, Ow.

No. S. A. 39. A block of triassic rock including a fragment of the fore part of the upper jaw, with the pair of canine teeth, somewhat mutilated, and a corresponding portion of the lower jaw, of *Cynodracon major*, Ow. This specimen is figured in Plate II. figs. 4 & 5, nat. size; fig. 6 magnified.

From a triassic rock at "Mildenhalls, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 40. the left humerus of *Cynodracon major*. Plate XVIII., nat. size.

If the foregoing fossil (S. A. 39) had been the sole evidence of its order, the resemblance in size and structure of the pair of canine teeth to those of the extinct feline mammal called *Machairodus*, and the improbability of the dentition of any reptile having been such as to leave as its representative a right and left upper canine tooth, descending on either side of the symphysis mandibulæ, with indications of smaller lower canines and incisors, might have engendered a belief that the mammalian carnivorous type had been realized at the remote period of the deposition of the triassic strata of South Africa and have supported a doubt as to the affinity of the fossil to the cold-blooded air-breathing class, as known, in 1874, through the existing and extinct species of Reptilia.

Such state or tendency of thought in the palæontologist would be heightened at the first glance of the fossil humerus associated with the canines. The breadth of the distal end, the extension of strong ridges from the outer and inner sides, just above the elbow-joint, indicative of the size and force of the supinator, flexor, and extensor muscles of the paw—the modifications of the articular surfaces of that end for the combination of due attachment of two bones of the fore leg with freedom of motion, not only in bending and extension, but for rotation on each other, so that the paw could be turned "prone" and "supine," whereby its application as an instrument for seizing and lacerating is advantaged; add to this the structure hitherto known only in the mammalian class and preeminently in the feline family, of a defence of the main artery and nerve of the forearm from compression during the action of the above-named muscles by a strong bridge of bone spanning across them—furthermore the extensive and powerful ridge at the proximal half of the humerus for the attachment of arm-muscles, especially the deltoid: each and all of these characteristics, which Cuvier especially dwells upon in contrasting the humerus of the feline and bovine mammals, are here for the first time exemplified in a fossil homologue, from a formation of the triassic, or at latest the liassic, division of geological time.

Extending, however, the comparison of the present humerus beyond the salient features above defined, the "head" of the bone (Plate XVIII. fig. 1, *a*) differs from that of the feline humerus in being broader transversely, instead of from before backward; the articular part is oblong and narrow, not hemispheroid nor nearly so convex. There is no elevation of an outer transverse tuberosity. The representative of the deltoid ridge (ib. *b*, *b'*), of similar basal extent to that in *Felis*, is more produced and is much thinner, extending as a broad plate of bone outward (radiad) and forward (thenad). It seems to be rather a development, in those directions, of the entire shaft than to be a superadded process of the shaft. The more rounded thickened character which prevails through nearly the whole extent of the humerus of the feline as of most mammals, is here confined to a constriction of barely an inch in extent between the subsidence of the deltoidal or delto-pectoral crest, and the beginning of the arterial bridge on the inner side and of the supinator crest on the outer side of the lower two fifths of the bone. The perforation itself is more highly placed, is further from the articular surface for the ulna than in *Felis*. The ulnar articulation or "trochlea" is less defined; the inner boundary ridge, so prominent in *Felis*, is here undeveloped. The convexity (ib. *g*) for the radius, on the other hand, is relatively larger, and its ball advances further upon the fore part of the shaft, in the present fossil. In this, likewise, the anconal pit, so deep and well defined by outer and inner ridges in *Felis*, is a mere wide and shallow depression.

Genus Cynodracon*, Ow.

The humerus of *Monitor niloticus* shows a minute perforation near the distal end; but it is in the "supinator" ridge, on the radial or outer instead of the ulnar or inner side*. In *Testudo elephantopus* also, Günther figures a similar minute oblique perforation on the radial side of the distal end of the humerus†. A corresponding perforation is more conspicuous in that bone of *Testudo Bartoni* and *T. inepta*, Gthr. It is an "ectepicondylar" canal. In no reptile, recent or fossil, have I observed the ulnar or "entepicondylar" canal, as in the feline mammals, save in the present theriodontal reptile and certain other carnivorous species from South Africa. Nevertheless, apart from this character and the mammalian proportions of length to breadth, the truly guiding modifications of the present humerus accord better with those of the humerus of the great herbivorous reptile, No. S. A. 24, figured in Plate XII., and of the humerus of the *Omosaurus*, also in the British Museum‡, than with the humerus of the Cat-tribe or of any other mammal.

From a triassic deposit at "Mildenhalls, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Genus Cynochampsa§, Ow.

Species *Cynochampsa laniarius*, Ow.

No. S. A. 41. The fore part of the skull, including the entire external nostril and the incisive and canine dentition of both upper and lower jaws. This part of the dental formula differs from that of the genus *Cynodracon* in the minor number of incisors; it is

$$\text{I.}\,\frac{4—4}{3—3},\ \text{C.}\,\frac{1—1}{1—1},\ \text{M.?}$$

The specimen is the subject of figs. 1–5, Plate XIX.

The eight upper incisors, four in each premaxillary, are arranged in a moderate curve along the fore part of the upper jaw; the roots are implanted with short intervals; but the crowns (broken away in the fossil) were probably in closer apposition. The lower incisors, six in number, have subcylindrical pointed crowns. The ends of the implanted roots of the four mid incisors have been broken across and are exposed, like the roots of the lower canines, by the fracture and removal of the lower part of the symphysis mandibulæ, as in fig. 4. The crowns of the upper canines (*c*, figs. 2, 3, 4) have been broken away, showing, as in the lower canines (fig. 4, *c'*), the pulp-cavity of the long deeply implanted fang. The crowns of the lower canines rose in advance of the upper and appear to have been received into cavities of the palate when the mouth, as in the fossil, was close shut. A portion of the crown is brought into view at *c*, figs. 2 & 4. In the alveolar border of the right maxillary, 8 lines behind the socket of the canine, is the fractured base of a minute simple molar. In the left alveolar border there is a faint trace of three such teeth.

The nostril is single, terminal, of a transversely oblong shape, with the plane of the outlet inclined from above downward and forward. This outlet is bounded below and laterally by the premaxillaries, and above by the nasals. The maxillo-premaxillary suture (*s*, figs. 2, 3, 5) is distinct, and demonstrates the small proportion of the upper jaw contributed by the premaxillaries (ib. 22). The extremity of the

* Monograph on *Omosaurus armatus* in the vol. of the Palæontographical Society issued in 1875, 4to, pl. xvii. fig. 6, *e'*.

† Phil. Trans. 1875, pl. 42. figs. A, A'.

‡ Monogr. cit. pl. xvii. figs. 1–5.

§ Gr. κύων, dog; χάμψα, an Egyptian name for the crocodile. This genus was defined in the 'Quarterly Journal of the Geological Society,' vol. xvi. 1860, p. 61. The author has since, by further clearance of the fossil, come to the belief that the portion of tooth supposed then to be a fifth incisor may be part of the crown of the lower canine.

upper jaw pierced by the nostril is slightly expanded as in the Teleosaur, in a less degree than in the Gavial. The nasal bones lose breadth as they recede from the nostril (15, fig. 1).

From a claystone nodule in a triassic formation of the Rhenosterberg, Cape of Good Hope.

Governor Sir George Grey, K.C.B. [P.].

No. S. A. 42. Portions of centrums of four thoracic vertebræ and a left coracoid of *Cynochampsa laniarius*. The articular surface for the scapula is oblong and narrow, flat and slightly convex; that for the humerus is broader and moderately concave. The body of the bone is broad, expanding beyond the constriction supporting the above articular surface, and sending off from the fore border a compressed process, shorter than in *Monitor*, with a flat synchondrosal surface for a cartilaginous or semiosseous epiphysis. As much of the articular surface of the centrum as is preserved shows a slight concavity.

No. S. A. 43. A right coracoid of *Cynochampsa laniarius*.

Both specimens are from a triassic formation of the Rhenosterberg, Cape of Good Hope.
Governor Sir George Grey, K.C.B. [P.].

No. S. A. 44. The proximal and distal portions of a left humerus of *Cynochampsa laniarius*. Plate XVIII. figs. 3, 4, 5.

The articular head (fig. 4) is relatively broader than in *Cynodracon* (fig. 2) and is more produced anconad (fig. 4, *a'*). The delto-pectoral crest (fig. 3, *b*, *b'*) is broader in proportion to the length of its base and is more produced thenad, augmenting the concavity of the proximal part of that aspect of the shaft. Beyond the crest this contracts to a trihedral shape, but in a greater degree than in *Cynodracon*. The beginning of the groove leading to the entepicondylar canal is here preserved. The canal itself (fig. 3, *g*, *g'*) is shown in the distal portion, with the same oblique course as in *Cynodracon*, from above downward, forward, and toward the mid line of the thenal aspect of the shaft. The ridge (fig. 1, *h'*) continued from the bridge (*h*) in that genus is not developed in the present. The ulnar (*f*) and radial (*e*) portions of the distal articular surface are subequal, feebly boundaried by a shallow and wide trochlear canal, and chiefly produced, as in Chelonia, upon the thenal surface (fig. 3). The supinator ridge is not developed as in *Cynodracon*. The anconal depression (*i*) is wide and shallow. There is no trace of medullary cavity in the contracted middle part of the shaft (fig. 6).

From a triassic formation of the Rhenosterberg, Cape of Good Hope.
Governor Sir George Grey, K.C.B. [P.].

Genus Cynosuchus*.

Species *Cynosuchus suppostus*, Ow.

No. S. A. 45. A cast of the fore part of the skull, showing the external nostril, and including the fore ends of both upper and lower jaws, these being in close apposition. The original specimen is figured in Plate XVI. figs. 1–5.

* Gr. κύων, dog; σοῦχος, crocodile.

The demonstration of the passing of the under jaw within the alveolar border and teeth of the upper jaw, the mouth being close-shut, is more plainly shown here than in No. S. A. 41, through the preservation of the alveolar border of the premaxillaries. *Cynosuchus* resembles *Cynochampsa* in the arrangement and relative position of the incisors and canines, and in the singleness and subterminal position of the external nostril; but it differs in the smaller relative size and more upward aspect of the nostril, and in the greater proportion of the maxillaries entering into the formation of its bony periphery. But the generic distinction of the species, the fragmentary fossil of which affords the present subject of description, is supported by the larger relative size of the molar teeth, of which the maxillary series commences nearer to the upper canine. This dental distinction is associated with an expansion instead of constriction of the upper jaw as it recedes, indicative of a broader and, probably, shorter skull. The nostril, likewise, is relatively smaller and more nearly horizontal. The simple teeth behind the canine, though small, are less minute than the base of the one preserved in *Cynochampsa* indicates them to have been in that genus.

The nasal bones (15, figs. 1 & 5) are broad, thick, and overlapped by the maxillaries (ib. 21). These are interposed at the upper half of the sides of the nostrils between the nasals and premaxillaries (22, figs. 2 & 3).

The premaxillaries gain in vertical extent at their median suture, and have risen, probably in a pointed form, in front of the nostril; but this ascending part (22, figs. 5 & 1) has been broken off. The contour of this part in profile is vertical or rather more prominent above than below (figs. 1 & 2, 22). The subcircular alveoli of the eight incisors (fig. 4 *i*, 1, 2, 3, 4), in each premaxillary, are in close contact, and describe a moderate curve convex forward. The premaxillo-maxillary suture (*s*, figs. 2, 3, 5) rises immediately behind the socket of the fourth incisor. The dark patch of matrix behind that socket, dividing it from the canine, assuredly does not hide an intervening socket or tooth-base; it indicates the position of the crown of the lower canine (*c'*, fig. 4).

The sockets of the upper canines make a slight prominence at the outer surface of the maxillaries; and a more feeble depression divides this from the premaxillary. A less feeble depression follows the alveolus; and then the upper jaw begins to expand more rapidly; but here the bone is broken away on both sides of the skull.

The upper canine (figs. 2–5, *c*, *c*), broken off on both sides of its emergence, shows a full ellipse, without indication of trenchant or serrate border. But what modifications the entire crown may show must wait better-preserved fossils for demonstration. The narrow sublinear termination of the pulp-cavity is exposed. Eight broken teeth, with subcylindrical crown-bases about half the size of the incisors, are shown in the right maxilla, and five or six similar ones in what remains of the left maxilla. These small serial teeth may be formulized by the character of position as molars. The alveolar border containing them describes a gentle convex curve.

The mandible (figs. 2–5, 32), at its symphysis, is considerably deeper than the premaxillary part of the skull to which it is opposed; but the transverse extent of so much of the lower jaw as is preserved is diminished so as to allow it to pass within the border of the upper jaw when the mouth is shut, to which it fits as a box to its lid, whence the specific name, referring to this relative position of the mandible.

So completely is it shut in that all trace of teeth or of alveolar openings is concealed. The relative size and position of the canines are indicated by an outswelling of the alveolar border in advance (as in Mammals) of the canine above.

The symphysial joint has not been obliterated by bony confluence. The fracture of the lower border of the rami exposes the splenial elements (fig. 4, 31), retaining their reptilian distinctness from the dentary elements (ib. 32) of the composite mandible. The texture of the skull-bones wherever exposed by fracture is singularly compact and ivory-like.

Cynosuchus and *Cynochampsa* belong, so far as can be deduced from characters given in two fragmentary types of their species, to the same single-nostrilled group of Theriodontal Saurians.

From a claystone nodule in a (triassic?) formation of the Sneewberg mountain-range.

The original, transmitted for the above determination and description, is in the Museum at Albany, Cape of Good Hope.

Genus Galesaurus*, Ow.

Species *Galesaurus planiceps*, Ow.

No. S. A. 46. The skull, somewhat mutilated, affording the subjects of figs. 6–11 of Plate XIX.

This fossil forms a contrast, by its broad, depressed or horizontally flattened form, with the narrow compressed shape of the skull in the binarial genera (Plates XIV. & XV.). The flattening is not due to posthumous pressure. The sharp and high ridges diverging from the parietal (7, fig. 8) to bound the occiput are entire; that surface inclines forward from the occipital foramen in an unusual degree before rising to form the crest; it is completely ossified, and offers a deep fossa for the implantation of powerful muscles, as in the Felines and Hyænas. The composition of the occipital surface is reptilian; the bones are indicated by the usual numerical symbols: *e. g.*, 2, exoccipital; 3, superoccipital; 4, paroccipital; 7, parietal; 8, mastoid; 11, frontal; 15, nasal. The plane of the occipital foramen partakes of the inclination of the occiput; the condyle is produced much behind the upper border of the foramen. There is a "foramen parietale" (fig. 8, 7′).

The under jaw passes, as in preceding Theriodonts, within the alveolar border of the upper jaw, the mouth being shut. On the right side of the fossil (fig. 6), three of the incisors, part of the canine, and a series of small, equal-sized, simple-crowned molars of the upper jaw are shown. On the left side, the alveolar plate of the upper jaw being removed, four incisors, the canine, and twelve conical equal-sized molars are exposed in the under jaw (fig. 7). The portion of the socket of the upper canine here remaining demonstrates the usual relative position of the upper and lower canines in the carnivorous mammals.

The nostril (fig. 10, *n*) is single and terminal. The symphysis mandibulæ (ib. & fig. 9, *s*) is short; the "mentum" recedes: the mandibular rami diverge from the linear trace of junction at an acute angle straight to the articular end. The orbit (*o*) is small, subtriangular, bounded behind by a postfronto-malar bar. The temporal fossa (*t*) is large, wide, of a rhomboid figure.

The reptilian nature of the fossil is shown by the single occipital condyle, the complex frontal bone, and the compound structure of the mandibular ramus. The crocodilian affinity is indicated by the single terminal nostril, the fixed tympanic, and the extent of ossification of the occiput; the more generalized saurian character is exemplified by the "foramen parietale" and by the large temporal fossæ. The latter character, in connexion with the dentition and the verticality of the single nasal aperture, is most nearly repeated by the carnivorous Mammalia. The breadth and flatness of the skull and the relative size and position of the orbits and temporal fossæ are similar to those of the genus *Simosaurus*, of the trias of Germany.

From the sandstone rocks of triassic age of the Rhenosterberg.
Governor Sir George Grey, K.C.B. [P.].

No. S. A. 47. The proximal and distal portions of the left humerus of *Galesaurus planiceps*.

It presents the same type of structure as in *Cynochampsa*, but is of a smaller size, with a thinner and less produced delto-pectoral crest.

From the same formation and locality.
Governor Sir George Grey, K.C.B. [P.].

* Gr. γαλῆ, weasel; σαῦρος, lizard. See 'Quarterly Journal of the Geological Society of London, vol. xvi. p. 58, 1859.

Genus NYTHOSAURUS*, Ow.

Species *Nythosaurus larvatus*, Ow.

No. S. A. 48. This specimen, the subject of figs. 1 & 2 of Plate XX., consists of little more than the nucleus of petrified sandstone occupying the cavity of the cranium and the interspaces of the maxillary and mandibular rami. The characters deducible therefrom indicate a genus allied to *Galesaurus*.

Part of the socket and crown of the left upper canine (fig. 1, *c*) is succeeded by a close-set series of similar, shorter, maxillary teeth, but fewer than in *Galesaurus*. The interval of the mandibular rami (fig. 2, *m*) shows their convergence at an acute angle and in nearly a straight line to the pointed or narrow anterior end of the lower jaw. The breadth of the hinder part of the skull must have exceeded the depth; and a similar flatness of the upper surface is indicated.

The left canine is followed by seven close-set laterally subcompressed teeth, inserted into sockets and apparently anchylosed thereto. The dentigerous part of the mandible is similarly limited to less than one half the length of the ramus. There are indications of the laterally compressed crown of the upper molars being notched at its somewhat expanded border. The molars in *Galesaurus* are too mutilated to show such character, if it existed.

The brain of this extinct reptile is instructively exemplified by the cast of the cerebral cavity, Plate XXXIV. fig. 2. The cerebellum, C, has the small relative size characteristic of the cold-blooded air-breathing vertebrata. It is relatively less than in the Crocodile and Turtle (*Chelone*), and shows more of the proportions of that part in the Lizards and Serpents. The optic lobes, O, are relatively longer than in the Python, and narrower in proportion to their length than in the Lizard. The cerebral lobes have the same breadth as the optic lobes; they are not broader as in the Python, nor narrower as in the Lizard: they are shorter than in existing Lacertilia, Chelonia, and Crocodilia. The cast of the olfactory chamber, R, would indicate a proportionally larger rhinencephalon and olfactory nerves than in the Lizard. The myelon, *m*, has almost the same breadth or thickness at its origin as the macromyelon supporting the cerebellum, C. The dura mater enclosing the pineal vessels in their course to the "foramen parietale" is represented in this natural cast. The brain, upon the whole, shows a lower development than in modern Reptilia.

From the triassic red sandstone of the "Tafelberg," Cape of Good Hope.

The original was transmitted for determination and description by the discoverer, W. Guybon Atherstone, M.D. [P.].

Genus SCALOPOSAURUS†, Ow.

Species *Scaloposaurus constrictus*, Ow.

No. S. A. 49. A cast of the skull (the original specimen is figured in Plate XVI. figs. 10–15).

It presents a broad depressed form, but contracts rapidly in front of the orbits, and again expands slightly at the alveoli for the canines, the part anterior to which is broken away. This constriction of the maxillary region suggested the specific name: the generic one relates to the small size of the fossil, which does not greatly exceed that of certain South-African Insectivores allied to the moles. The upper canines are relatively smaller than those of *Galesaurus*; and the succeeding molars, 12 in number, in the right maxillary, are relatively longer and more slender. The lower canines are in advance of the upper, and

* *νυθὸς*, obscure; *σαῦρος*, lizard.

† Gr. *σκάλοψ*, mole; *σαῦρος*, lizard.

between them are indications of incisors: these show that not much of the fore end of the skull is wanting. The overlapping relation of the upper to the lower jaw is here also exhibited.

The occiput (fig. 13) is mutilated; débris of the basi- (1) and ex- (2) occipitals bound the lower half of the occipital foramen (*oc*); the upper part is overarched by the superoccipital (3). This seems to be separated, as in Lacertilia, from the parietal productions (7, 7) by an unossified space. These productions are mainly extended outward by the mastoids (8, 8), which expand as they recede and descend to join the paroccipitals.

The temporal fossæ (figs. 10, 14, 15, *t*) do not exceed the orbits (ib. *o*) in size: slender transverse postfrontals combining with malars divide these vacuities. The parietals are broad and flat between the temporal fossæ. The interorbital part of the frontal (11) is still broader. The prefrontals (14) and lacrymals (73) bound by subequal and subquadrate plates the fore part of the orbits. The nasals (15) and maxillaries (21) are indicated by those numbers in the figures; they show mammalian proportions. The mandibular rami describe a sigmoid curve from their broad articular end to the narrower symphysis (fig. 11, *s*). The articular with the surangular (29), the angular (30), the splenial (31), and the dentary (32) are indicated by those numerical symbols in figs. 14 and 15. The modifications of the skull in relation to the muscles of the lower jaw accord with the minor development of the canines and the general insectivorous character of the dentition.

From the lias-like claystone of the Sneewberg, South Africa.

The cast has been taken by permission of the Directors of the Albany Museum, Cape of Good Hope, by whom the original fossil was transmitted for the purpose of the present determination and description.

Genus Procolophon*.

Species *Procolophon trigoniceps*, Ow.

No. S. A. 50. Cast of the skull. The original specimen is figured of the natural size in Plate XX. figs. 4–7.

One feature characterizing the skull of *Galesaurus planiceps*, besides that which suggested the specific name, is the convergence by straight lines of the sides of the facial part forward almost to a point. This character is repeated with a minor relative degree of flattening and depression of the skull in the present and succeeding fossils. The character which suggested the generic name is the more marked through the breadth and shortness of the cranial or postorbital part of the skull, the horizontal view showing an almost equilateral triangular figure (as at fig. 4, Plate XX.). That no part of the cranium is wanting posterior to the hind border of the upper surface (ib. 3, 8) displayed in the fossil, is testified by the entireness of the mandibular rami, the angular elements (20) of which slightly project behind the tympanic articular surface, which terminates a fixed pedicle (ib. fig. 5, 28) inclining somewhat forwards from the mastoid angle (8) of the occipital plane. The superoccipital line is transverse, slightly undulate in that direction; it does not rise at the mid part, but there extends slightly backward. A strong mastoid (8), which forms the angle, shows an outer and a hinder subquadrate facet, and sends down a narrower portion abutting against and overlapping the tympanic (28) in advance, halfway down to its mandibular end. A broad squamosal (ib. fig. 6, 27) overlaps both elements of the pedicle.

The parietal extends forward from the superoccipital angle without sutural indication of an interparietal or any extension of the superoccipital upon the upper surface of the cranium. The parietal or pineal vacuity (fig. 4, 7) is relatively large, of a full oval form. The orbits, *o*, are unusually large, suboval, with the long axis parallel with that of the skull, and the smaller end of the aperture extending back beyond the foramen parietale. The temporal space (fig. 6, *t*) is uncovered and is smaller than the orbit;

* Gr. πρὸ, before; κολοφὼν, apex.

it is bounded above by the mastoid (8) and postfrontal (12), below by the squamosal (27); the fore part of this broad plate is received into the angle formed by the postorbital and zygomatic branches of the malar (26). The nasals (15) are broader than the frontals (11); and their hind part or base swells out in front of the orbit, indicative of an expansion there of the olfactory chamber. The exterior nostril shows no trace of septum: it appears to have been single; it is terminal (ib. fig. 7, *n*). Part of the premaxillary forming the lower border of the aperture is wanting; but the plane of that aperture appears to have been vertical. Indications of premaxillary teeth are present, but scanty. The opposing teeth of the mandible are preserved. The foremost, rising with a slight forward inclination from the symphysis, has a slender conical crown; it is followed by five similar but seemingly rather smaller teeth, the points of which fit into interspaces of similar conical maxillary teeth, where these are preserved. Five hinder maxillary teeth are present on both sides; they are close-set, allowing the lower teeth to pass only into the intervals due to the conical shape of the crown. There is not space for more than one small maxillary tooth between those in place and the premaxillary teeth. The débris of these indicate them to have had a like simple pointed conical shape, and to have been of rather smaller size than the maxillary teeth. There is no tooth in either upper or lower jaw resembling a canine by superiority of size. The hindmost maxillary tooth in place projects below the anterior fourth part of the suborbital branch of the maxillary, and in such relative position to the coronoid angle of the mandible as to show that tooth to terminate the series. I estimate that there were ten or at most eleven teeth on each side of the upper jaw, and eight or nine on each side of the lower jaw—all sharp-pointed, or of the insectivorous type. A pulp-cavity extending into the exserted crown is exposed by removal of the outer wall of that part. The base of the tooth seems to be confluent with the osseous substance of the jaw: there is no appearance of an alveolar cavity.

From the triassic red sandstone of the "Tafelberg," Cape of Good Hope.

The original was transmitted for determination and description by the discoverer, W. Guybon Atherstone, M.D.

Species *Procolophon minor*, Ow.

No. S. A. 51. Cast of the skull. The original specimen is figured of the natural size in Plate XX. figs. 8–12.

The original of the present cast, besides its inferiority of size to that of S. A. 50, differs in the smaller relative size of the anterior mandibular teeth; but the mutilated state of these, by which the coronal pulp-cavity is exposed, renders such differential character somewhat dubious. A better one is offered by a linear osseous narial septum (ib. fig. 11). The close correspondence in all other respects suggests a possibility that the specimen may be the skull of a younger individual of *Procolophon trigoniceps*. Its condition adds a (generic?) dental character not shown by the larger skull. The right premaxillary of the present specimen has four close-set conical teeth, seemingly of but half the length of the maxillary teeth, which continue the series. Of these latter teeth three are preserved, in the interspaces of the crowns of which fit the apices of those of the two hinder mandibular teeth preserved on the right side. In this ramus the five foremost teeth are shown. In the left ramus there are eight teeth, three of which follow the one answering to the fifth on the right side. The number of maxillary teeth on the left side is six; and the two hindermost of the premaxillary series are shown. The dental formula of *Procolophon* may be given, on present evidence, as

$$\text{I.}\,\frac{4—4}{2—2},\ \text{M.}\,\frac{6—6}{6—6},=36.$$

From the triassic sandstone of the "Tafelberg," Cape of Good Hope.

The original was transmitted for determination and description by the discoverer, W. Guybon Atherstone, M.D.

portions of the implanted part of four incisors in a curved series, and of a larger tooth behind having the

Fam. TECTINARIALIA.

Genus Gorgonops*, Ow.

Species *Gorgonops torvus*, Ow.

No. S. A. 52. The cranium, somewhat mutilated. It is the subject of Plates XXI. & XXII.

This specimen has been relieved or worked out of one of the hardest and most intractable blocks of triassic (?) matrix hitherto received from South Africa. It is a skull, wanting the mandible, of a theriodontal reptile, with some mutilation of the basal, postero-lateral, and posterior surfaces. Enough is preserved to show a subdepressed subelongate form, retaining the general breadth of the facial part from the orbits to near the fore end, which is obtusely rounded. The cranium is flattened above along the hinder two thirds; the depth of the parts sufficiently entire to give or indicate vertical diameter shows this to be less than the transverse one. In this general form, as in the extent or completeness of ossification, especially along the roof of the temporal fossæ, some Alligators, among living reptiles, offer an approach to the present extinct form of reptile. A closer resemblance to it is shown by the skull of the ganocephalous *Archegosaurus*. But the recognizable type of structure is that of the higher members of the reptilian class; and so much of the dentition as is preserved or determinable presents, as in other Theriodonts, the characters rather of that in a carnivorous marsupial than in any Crocodilian reptile.

The specimen being figured from four aspects of the natural size in Plates XXI. & XXII., the dimensions, save of some particulars, are not here given.

Enough remains of the occiput to indicate that the condyle was single. The matrix occupying the brain-cavity shows the foramen magnum to have been 5 lines in breadth, 3 lines in depth. If the ex-occipitals have joined to complete the upper frame of the foramen, their median suture is obliterated; but it may be that the keystone of the arch was formed by the superoccipital element. This slopes forward, slowly rising at first and then climbing with a steeper slope to the superoccipital ridge. A broadish, smooth, round, median rising (Plate XXII. fig. 4, 3) divides the lower slope into a right and a left shallow depression; a narrower and rather sharper ridge (3′) bisects the upper two thirds of the occipital slope. The sides of this, so far as they are preserved, bend gently backward as they recede. The par-occipitals and mastoids are broken away. The smooth upper surface (Plates XXI. & XXII. fig. 1, *t*) of the natural cast of the temporal fossa shows the fine markings of the under surface of the bony roof, the median portion of which (ib. ib. fig. 1, 7) is preserved on the left side. It is a line in thickness where it has been broken away from the superoccipital expansion; the fractured border shows 2 lines thickness of dense bone.

The parietal has the upper median, or pineal, perforation (Plate XXI. fig. 1, 7) about half an inch in advance of the superoccipital ridge. Anterior to the "foramen parietale" the expanse of bone continued to the orbit is undulate, two obtuse longitudinal ridges dividing three shallow channels. A broader median ridge (ib. 11) rising about an inch anterior to the foramen (7) divides the frontal region. There is no trace of a median or frontal suture. Of those between the fore parts of the frontals and the diverging hind ends of the nasals there are but obscure and feeble traces.

The orbit (Plate XXII. fig. 1, *o*) is relatively small, wholly in the hinder half of the skull, subquadrate, the antero-posterior diameter being twice that of the vertical one. The upper, rather thick and rugged border is contributed by the frontal (11), the hind border by the postfrontal (8), the fore border by a pre-frontal or prefronto-lacrymal (14, 73), the lower border by the malar (26). The extent of the vertical suture preserved between the malar and the postfrontal is 10 lines. The lower half of the postfrontal (12) overlaps the corresponding part of the zygoma: it is continued backward into the temporal roof; but the postorbital part is divided from the temporal part of the postfrontal by a low ridge. The mastoidal contribution to the roof of the temporal fossa is wanting, but has left its impression (8) on the matrix. The

* Gr. γοργών, gorgon; ὤψ, aspect.

it is bounded above by the mastoid (8) and postfrontal (12), below by the squamosal (27); the fore part of

lower part of the deep and thick zygomatic arch is broken away. The depth of the remaining part beneath the hind half of the orbit is one inch. One surmises that a physiognomical character of the skull, exaggerated in *Pareiasaurus*, may also have marked, in a minor degree, that of *Gorgonops*.

Anterior to the orbit the side-wall of the skull shows a depression (21, fig. 1, Plate XXII.), deepening to the fore part or pier of the zygomatic arch, which suddenly swells out. But there may have been some crush or distortion of this part of the cranial wall, since the depression here is less on the right than on the left side of the face.

The naso-maxillary part of the skull is rather less deep than it is broad. The nasals (Plate XXI. fig. 1, 15, 15) are 1 inch 9 lines across just behind the nostrils; they then contract to a breadth of 1 inch 2 lines midway between their fore and hind ends; the latter diverge to receive the fore part of the frontal, where the breadth of the skull at the outer border of the nasals is 2 inches 6 lines. The upper border of the maxillary (Plate XXII. 21) is convex; it projects on the left side of the skull a little above the general surface, owing to a slight posthumous depression there of the nasals. The suture of the maxillary with the premaxillary is not clearly recognizable. The nostrils (Plate XXIII. fig. 3, *n*, *n*) are small, very narrow, especially vertically, 9 lines in length; widest behind, where their extreme depth does not exceed 3 lines, and narrowing almost to a point anteriorly: each is overhung by a thick subangular border of the nasal bone. The mid interspace formed by junction of the nasals with the premaxillaries is 1 inch in breadth.

The depth of the fore part of the premaxillary, as far as preserved, is 10 lines; but the alveolar border is broken away, exposing the roots and pulp-cavities of the incisors. Of these I clearly make out five on the right side, and, though less clearly, as many on the left side.

The section of each incisor at the base of the crown gives a full oval, with the long axis extending from the outer to the inner wall of their socket. They are close-set; the three middle, in each lateral series, are somewhat larger than the first and fifth. No indication is afforded of the shape or structure of the enamelled crown.

In the thicker alveolar border of each maxillary there was the faint indication of the socket of a larger canine tooth (as at Plate XXI. fig. 2, *c*, *c*). But the difficulty of working out the present fossil has mainly arisen from the slight difference in colour of bone and matrix, at least on the surface. To test the above appearance I caused the lapidary to take a horizontal slice from the alveolar border; and this exposed an undoubted socket of a large canine, in both right and left maxillary, filled with matrix retaining its dark colour (as at fig. 3, Plate XXI.). The section of this socket is elliptical, 7 lines by $5\frac{1}{2}$ lines; the long axis is longitudinal.

Behind the empty socket of the right upper canine was the trace of the shell of an imperfectly formed crown of apparently a successional tooth, figs. 2 and 3, $\ddot{c}$.

Obscure and doubtful indications of simple teeth, smaller than the canines, appear in the maxillary at some distance behind the canines (as at *m*, *m*, fig. 2, Plate XXI.).

The general form of the skull and especially the contracted nostrils, which are so peculiar a feature of its fore part, have weighed with me in placing the singular reptile so represented in a distinct family from the typical "binarial" Theriodonts, in which, as in the "mononarials," the temporal fossæ are not roofed over by bone. There is something in the extent of ossification of the roof of the hind part of the cranium which recalls the physiognomy of the Labyrinthodont skull.

From a triassic deposit at "Mildenhalls, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *incertæ sedis*.

No. S. A. 53. A waterworn nodule of apparently the symphysial end of a mandibular ramus.

Some obscure indications of teeth being traceable, a section was made of this fossil, which demonstrates

portions of the implanted part of four incisors in a curved series, and of a larger tooth behind having the character of a canine. The pulp-cavity is exposed in each tooth-section: it is large; and $1\frac{1}{2}$ inch of its longitudinal extent is shown in the corresponding implanted part of the canine, the dentinal wall of the cavity being thin and decreasing to the implanted base.

The singular and suggestive concordance of dentition in certain cold-blooded air-breathing vertebrates of South Africa with that in carnivorous mammals justifies their relegation to a distinct group equivalent to that of an order in the class Reptilia; and for this group the name *Theriodontia* is proposed, significant of the chief ordinal character. Since the detection of this character in two fossils from South Africa, the types of the genera *Galesaurus* and *Cynochampsa* * (each represented by a single species of small size, assuming the fossils to be from full-grown animals), other and larger forms have successively reached the British Museum: some of these, again like mammals, have the external bony nostril single, median, and, as in most Carnivora, terminal; others have that nostril divided into two apertures by a premaxillo-nasal septum, as in Dinosaurs and most other reptiles.

But to the mononarial and binarial families of Theriodontia a third subordinate group may be added, of which the genus *Gorgonops* is the type. In this the nostrils are divided by a broader interspace of bone, and they are singularly small in proportion to the size of the skull, and are overarched by the thick roof of bone, whence the name "tectinarial," proposed for the family of Theriodontia of which *Gorgonops torvus* is the type.

In no previously known Reptilia have shape- and size-characters of teeth been so differentiated in accordance with characters of relative position, thereby vindicating the claims of such teeth to be noted as "incisors," "canines," "molars," as in the South-African Saurians here grouped together under the proposed ordinal term. The objection to calling "molars" the small and simple conical teeth following the large canines, is equally applicable to the curiously similar small and simple teeth which follow the huge canines in the maxillaries of the Walrus.

The concluding operations of the molars, in most Seals, upon the food seized by their canines must have been of as simple a nature, rather piercing than pounding, as would be effected by the teeth of the Theriodont reptiles here formulized as "molars." The incisors are in most species in excess of the number present in the higher (gyrencephalous) Carnivora; but in the lower (lyencephalous or marsupial) forms of Mammals they repeat in certain species (e. g. *Dasyurus, Thylacinus, Didelphys*) the numbers given in the dental formulæ of *Cynodracon, Cynochampsa*, and *Gorgonops*.

Order ANOMODONTIA†, Ow.

Teeth wanting or limited to a single pair, having the form and proportion of tusks, or several and small, but limited to the bony palate and to the inner part of the mandibular alveolar border.

The first two families defined by dental characters also yield the following ordinal ones, viz.:—a "foramen parietale;" two external nostrils; tympanic pedicle fixed; vertebræ biconcave; anterior trunk-ribs with a bifurcate proximal end; sacrum of more than two vertebræ; ischio-pubic symphysis continuous. Such, also, may be the associated characters of the third family; but materials in proof or otherwise are at present wanting.

* Quarterly Journal of the Geological Society of London, vol. xvi. p. 58 (1859).

† Gr. *ἄνομος*, anomalous; *ὀδούς*, tooth.

Fam. BIDENTALIA*, Bain.

A long ever-growing tusk in each maxillary; premaxillaries connate, forming with the lower jaw a beak-shaped mouth, probably sheathed with horn. Sacrum of more than two vertebræ; trunk-vertebræ amphicœlian; limbs ambulatory.

Genus Dicynodon†, Ow.

Char. The fronto-parietal plane (Plate XXIII. fig. 1, *f–p*) is continued by a greater or less curve into the fronto-nasal plane (ib. ib. *f–n*) of the skull.

Species *Dicynodon lacerticeps*, Ow.

No. S. A. 54. The skull, on which both genus and species was founded. It exemplifies the rare condition of petrefaction with that of its bed or matrix without detachment of the lower jaw from its natural articulations with the tympanic pedicles. This type specimen is the subject of Plate XXIII.

The base of the broken occipital condyle (fig. 3, 1, 2) is subsemicircular; the fractured surface permits the definition of the proportions contributed by the basioccipital (1) and the exoccipitals (2). The foramen magnum is vertically oblong; it is formed by the exoccipitals, which rise to an extent equal to that of the vertical diameter of the foramen, *f*, and expand laterally for the same extent, uniting with the parieto-mastoid ridge; this overhangs the occiput like a penthouse, and is bent upon the superoccipital in the form of a gable-roof at a right angle (7-8). A portion of matrix, *m*, indicates a small vacuity answering to that (superoccipito-mastoid) on each side of the superoccipital in the Crocodile. Each exoccipital sends outward an abutment (2′) against the descending part of the mastoid (8′), separated by a notch or (exoccipito-mastoid) vacuity, *n*, from the exoccipital plate above and by a second (paroccipito-mastoid) notch, *o*, from the paroccipital (4) below. The latter element is confluent, as in the Crocodile, with the exoccipital; its broader process abuts against both mastoid and tympanic. The two latter unossified tracts on the occipital surface are not present in the Crocodilia; but all three are blended into one wide vacuity in Lacertia (*Varanus*, e. g.). The extent of ossification of the occiput in the present type skull of Dicynodontia resembles more closely that in Crocodilia. The foramen (fig. 3, *t*) on each side of the condyle answers to both the precondyloid and jugular foramina in the Crocodile‡: it would give issue in *Dicynodon* to the vagal and hypoglossal nerves as well as to the vein from the tympanic cavity. A pair of thick, short, subtruncate hypapophyses (ib. 1′, 1′) project downward and a little outward from the sides of the under surface of the basioccipital.

The origins of the crotaphyte muscles, the mass of which is indicated by the expanse of the temporal vacuities (fig. 2, *t*), extended upon the parietals, *t′*, to the sagittal line. Hence their boundaries recede from each other and curve outwardly to the postfrontals (ib. 8): in the interspace opens the "parietal foramen" (7). This foramen is a character distinguishing the lacertian from the crocodilian reptiles.

* "Bidentals," A. G. Bain:—"It is immediately to the north of Dans Hoogte that the district begins which has furnished the remains of the remarkable bidental reptiles, the discovery of which has induced me to make the present communication." See "Letter," cited, p. 6, from 'Transactions of the Geological Society of London,' vol. vii. 2nd ser., 4to, 1845-1856.

† Gr. *δις*, two; *κυνόδους*, a term applied by Hippocrates to the canine teeth.

‡ Philosophical Transactions, 1850, p. 522, pl. xi. fig. 1.

A few lines in advance of the lower border of the occipital condyle the basioccipital sends downwards

The sagittal suture is obliterated, if it existed. The interfrontal suture is present (between 11, 11, fig. 2). The frontal contributes the major part of the upper border of the orbit; the rest of that border is formed by a postfrontal (8) and prefrontal (14). The lacrymal (fig. 1, 73) completes the fore border of the orbit and extends forward upon the face. The orbit (fig. 1, *o*) is subcircular and large; it opens upon the middle third of the side of the skull. The nostrils, *n*, are lateral, half an inch in advance of the orbits, divided above by about the same extent of the nasal bones (15, fig. 2). The premaxillary end of the skull is wanting. The maxillary contributes the socket of a large, round, pointed, and slightly curved canine tusk (fig. 1, *c*) directed forward and obliquely downward; the point passes outside the fore part of the mandible (32) in the closed state of the mouth, as shown in the present fossil. The base of the tusk and the pulp-cavity are shown on the right side, commencing close to the lower maxillary border of the orbit. The matrix filling the pulp-cavity retains a reddish colour, as if from the hæmatosine of that highly vascular organ. A portion of the palatal bone is exposed on the right side (fig. 1, 20) abutting against the alveolar part of the maxillary in front and joining the pterygoid (24) behind. A strong zygomatic arch continued backward from the maxillary includes malar (26) and squamosal (27) elements, and abuts against the mastoid and tympanic. It is, however, mutilated in the present specimen. The tympanic pedicle, formed by the mastoid (8), squamosal (27), and tympanic (28), is directed downward and a little forward, departing more than in *Varanus* and most other Lizards from the position of the pedicle in Crocodiles, in which it inclines backward. The mandible is thus shorter in *Dicynodon* in proportion to the skull; its supporting pedicle or column is fixed by the paroccipital and squamosal abutments, as in the Crocodiles.

The following elements may be traced in the side view of the mandibular ramus (fig. 1)—the angular (30), surangular (31), dentary (32), with indications of a vacuity, *v*; in the under view (fig. 4) is seen the splenial element (31′). There does not appear to have been a prolongation of the angular beyond the articulation with the tympanic. The mandible gains in vertical extent as it advances for one third of its length, contracts laterally to give passage to the tusks (fig. 5, *c*, *c*), and again expands at its terminal third, where the symphysis curves upward to meet the premaxillary. There is no trace of tooth in the lower jaw. The profile contour of the skull is a slightly undulate, mainly convex, curve (fig. 1).

The reptilian character is manifested by the small relative size of the cerebral part (fig. 2, *t′*, 7); by the persistence of the sutures of the neurapophyses and spines of the occipital, frontal, and nasal vertebræ. The crocodilian affinity is indicated by the well-ossified occiput and the fixed tympanic; the lacertian affinity by the divided nostrils and the parietal foramen: the edentulous trenchant border of the lower jaw is a chelonian character; but the large downwardly prolonged pair of canine tusks seem borrowed, as it were, from the mammalian Walrus (*Trichechus rosmarus*). The proportion of breadth to length and the relative size of the temporal fossæ are rather mammalian features than crocodilian or lacertian.

From a triassic formation in the "Tarka prolongation of the Winterberg range of mountains," Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 55. Anterior portion of a lower jaw of a *Dicynodon*, from a rather larger individual of, apparently, *D. lacerticeps*.

The outer wall being here preserved, the constriction on each side of the symphysis for the passage of the tusks and the commencement of the longitudinal ridge behind the constriction are shown. The alveolar border presents a narrow groove.

From a triassic formation in the "Tarka prolongation of the Winterberg range of mountains," Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

Fam. BIDENTALIA* Bain.

Species *Dicynodon leoniceps*, Ow.

No. S. A. 56. The skull, somewhat mutilated on the left side and fore end and wanting the lower jaw. It is figured in Plates XXIV., XXV., and XXVI. of the natural size.

This is not an old individual or large variety of *Dicynodon lacerticeps*. The evidence of the full development of the temporal muscles is as strongly shown in the smaller skull, No. S. A. 54, as in the present larger one. Besides the character of size, *D. leoniceps* differs in the smaller proportion and more anterior position of the orbits (Plate XXIV., *o*) and in the less oblique, almost vertical direction of the canines (ib. *c*); the postorbital extent of the skull is relatively much greater in the present species. The representative specimen exhibits the occipital condyle entire (Plate XXIV. 1, Plate XXVI. fig. 2, 1), the structure of the supporting pedicle of the lower jaw, and the configuration of the terminal joint of the tympanic (Plate XXVI. 28). Much of the palatal organization has been brought into view by skilful removal of the matrix, which could not be wrought out without detaching the mandible in the smaller species (No. S. A. 54). The occipital condyle is subhemispheroid, with a slightly emarginate base, of 2 inches extent toward the foramen magnum. The ex- and super-occipital plates extend 6 inches above the foramen; the expanded occiput seems to have been crushed by lateral pressure into a pair of plates meeting at a right angle along a median vertical fracture extending from a superior depression for the insertion of powerful nuchal muscles or ligaments down to the foramen magnum. The upper angles of the occipital surface are formed by massive mastoids, which lose breadth as they descend, continuing in union with the super- and ex-occipital elements for an extent of 5 inches; then, after an interval or vacuity of $1\frac{1}{2}$ inch, regaining thickness and articulating with the thickened ends of the paroccipitals. Each of these bones (Plate XXVI. fig. 2, 4), expanding to a vertical breadth of $2\frac{1}{2}$ inches, is closely applied to the same extent of the masto-tympanic pedicle, the tympanic portion (ib. 28) freely projecting 1 inch 10 lines below and beyond the paroccipital buttress.

In this character the *Dicynodon* resembles the Crocodile and differs from the Lizard (*Varanus*), in which the lower angle only of the paroccipital articulates with a concavo-convex facet upon the hinder part of the upper (proximal) end of the tympanic, the body of that pedicle projecting below the articulation afforded by the paroccipital with the mastoid and squamosal.

Varanus comes nearer than *Crocodilus* to *Dicynodon* in the trochlear character of the lower (distal) articular surface of the tympanic; but this character is extreme in the South-African reptile (ib. fig. 1, 28, 28). Two condyles (ib. *c*, *c*) are divided by a deep groove (ib. *g*), the breadth of which equals that of each condyle. The condylar convexities run lengthwise, slightly diverging as they extend forward; the inner one is rather longer and narrower than the outer. The intercondylar concavity is transverse; lengthwise its convex curve is almost that of each condyle. The joint resembles rather that of the distal end of a ruminant's humerus or of an avian tibia than that of the tympanic pedicle in any existing reptile. The close and firm joint, with movements restricted to the vertical direction, as in opening and shutting the mouth, indicates, with the magnitude of the temporal muscles, the force with which the trenchant border of the mandible was brought to bear upon that at the fore part of the upper jaw and upon the canines terminating that border.

The tympanic process of the mastoid descends to near the neck of the outer condyle, and expands as it is applied to the hinder surface of the tympanic, articulating with that and with the paroccipital, wedged as it were in firm sutural union between those bones. The tympanic process of the squamosal curves abruptly downward along the outer and fore part of the mastoid and contiguous part of the tympanic to the neck of the outer condyle.

In *Crocodilus* the tympanic and its supports are directed obliquely outward, downward, and backward. In *Varanus* the masto-squamosal supports of the tympanic curve down to their articulations with that vertically extended bone. In *Dicynodon* the tympanic with its supporting masto-squamosal column is directed downward and forward as in the type skull (S. A. 54). But the composition of the tympanic and its supporting column and buttresses, and the configuration of the articular surface for the mandible, not shown in that specimen, are clearly traceable in the skull of the present gigantic species.

A few lines in advance of the lower border of the occipital condyle the basioccipital sends downwards a pair of (hypapophysial) processes (Plate XXVI. 1′, 1′). Each is 1½ inch in length, 1 inch 9 lines in antero-posterior basal breadth, 1 inch 3 lines in corresponding apical breadth, and the same transversely. The free termination is convex and rough: the interval between the processes is 6 lines; they have afforded a favourable fulcral attachment to a pair of powerful muscles.

The basisphenoid (Plate XXVI. fig. 1, 5) meets, at almost a right angle, the basioccipital at the fore part of the base of the processes (1′, 1′), to which it contributes a portion. As the basisphenoid advances it is underlapped by the pterygoids, which join each other at the median line (ib. 24). From this junction each pterygoid sends backward, outward, and downward a process (ib. 24′) abutting against the inner and fore part of the tympanic just above the fore end of the inner and longer condyle (ib. *c*). The length of this tympanic process is 2 inches 3 lines; its least transverse breadth near its origin is 6 lines; it expands to a breadth of 1 inch where it abuts upon the tympanic. No such process or abutment of the entopterygoid exists in *Crocodilus*; but it is repeated in *Varanus* and most Lizards. There is a trace of a short but thick pterapophysis of the basisphenoid where the processes diverge from the body of the entopterygoid. The breadth of the united bodies is 1 inch 10 lines; the length is 1 inch 9 lines. Anteriorly each entopterygoid extends forward and slightly outward, and bifurcates or is notched below to receive the hind end of the palatine (ib. 20). The breadth of each notched production is 1 inch 1 line; the length to the end of the inner division of the seeming fork is 1 inch 3 lines. This branch (ib. 24*) projects, narrow and pointed, a short way into the interpalatal vacuity, marking off with its fellow a hinder median elliptical tract, which may be circumscribed by the meeting of the incurved slender ends of these processes of the entopterygoids. The length of the interpterygoid vacuity would thus be 1 inch 5 lines, its breadth 6 lines. The colour of the petrified bone and dark matrix is here so much alike that the distinction of one from the other becomes not clearly definable.

Each palatine bone begins anteriorly by a broad or thick bifurcate part, which receives, or joins by gomphosis with, a process of the maxillary (ib. 21′), continued backward from the socket of the great tusk. The breadth of the palatine at the bifurcation for this gomphosis is 1 inch 8 lines. The inner branch is slender, extends forward and inward, meeting its fellow of the opposite side, and defines anteriorly (ib. 20*) the interpalatal vacuity. This is 2 inches 6 lines in length from the recognizable fore part of the interpterygoid aperture (ib. 24*); but it extends backward outside the processes defining that aperture: the total length of the interpalatal vacuity is 3 inches 6 lines; its extreme breadth is 1 inch 6 lines. The bony palate in advance of the vacuity is wanting, together with the alveolar border anterior to the tusks, leaving open the following questions:—To what extent might the above-defined vacuities in the bony roof of the mouth be covered by a palatal membrane? What proportion was left uncovered for the passage of air to and from the narial meatus? In other words, was the inner, hinder, or palatal nostril interpalatal or interpterygoid, or partly bounded by both bones? Crocodilian analogy points to a single interpterygoid "palatonaris," Lacertian analogy to a share being contributed by the palatine bones to that aperture. There are no palatal vacuities, in *Dicynodon*, between the palatine and maxillary bones, as in Lacertilia†, Chelonia‡, and Batrachia§. In these reptiles each entopterygoid is distinct from its fellow; but the intervening space is relatively less than in Batrachia. In *Dicynodon* the entopterygoids have come together and become united along the mid line of the palate, perhaps suturally, as in Crocodilia‖; but this is here not clearly determinable. Another step in advance is made by the Dicynodont reptile in the absence of that ossification of the basal blastema of the cranium to which, in the Crocodile, the name "ectopterygoid" is applied; consequently the apertures between the ectopterygoids and palatines, which are added to the interpterygoid and palato-maxillary ones in Lacertilia, are wanting in Dicynodontia; and, in the absence of the ectopterygoids, another character in common with the Mammalia is manifested by the present family of South-African Reptilia. The interpalatal vacuity calls to mind such defect of ossification of the roof of the mouth in many Marsupials.

If the mastoid angle bounding the upper part of the occiput and the premaxillary end of the fore part of the skull of *Dicynodon leoniceps* were entire, the total length might be reckoned at not less than 2 feet; the length of the mutilated fossil is 1 foot 7 inches. Both orbits and nostrils open upon the

† Owen, Anat. of Vertebrates, vol. i. p. 157, fig. 98, D. ‡ Ib. ib. B. § Ib. ib. A. ‖ Ib. ib. C.

anterior half of the skull; the posterior half is devoted to the cranial cavity and the temporal fossæ. The length of the upper aperture of the fossa (Plate XXV. *t*, *t*) is 8 inches; if the mastoid part of the peripheral wall were entire, 4 inches might be added to the extent of the bony surface giving attachment to the temporal muscle. The lower aperture (Plate XXVI. fig. 1, *t'*, *t'*) is $8\frac{1}{2}$ inches in length, 4 inches in extreme breadth; the breadth of the upper aperture is little more than 2 inches where the fossa sinks beneath the zygoma; but the breadth at the upper margin of the muscular origins is more than double that extent. In the present species, or specimen, the parietal ridged portions of the periphery of the muscular origins almost meet at the upper part of the cranium; a linear groove divides the ridges along the middle of the parietal region or line of the sagittal suture (Plate XXV. 7). Where the ridges begin to diverge toward the postfrontals the pineal or parietal foramen opens. Each ridge divides at this foramen; and the two divisions curve with slight divergence to the postfrontal, including a smooth depression (ib. 12, 12), so defined from the depression of the general surface of origin of the temporal muscle.

The open or exposed condition of the upper aperture of the temporal fossa gives a mammalian carnivorous character to this reptilian skull. The development of the zygomatic arch, formed by the malar, squamosal, and mastoid bones, is exemplified by better-preserved specimens next to be described.

The orbit of *Dicynodon leoniceps* is subcircular, the hinder part less curved than the rest of the border; the plane of the aperture is nearly vertical, the lower border projecting a little beyond the upper. The vertical, like the longitudinal, diameter of the orbit is 3 inches (Plate XXIV. *o*).

The postfrontal (ib. 12) and prefrontal (ib. 14) portions of the upper boundary are more prominent and thicker than the intervening tract due to the frontal bone (ib. 11). The interorbital tract of the frontals is 5 inches across, flat, with a feeble rising along the interfrontal suture (Plate XXV. 11). This runs forward almost in a line with the sagittal suture; and the cranial profile begins to bend down upon the face parallel with the fore part of the orbit, whence it descends obliquely forward with a slight convex curve to the fractured remains of the premaxillary. At the fore border of the orbit the lacrymal (Plate XXIV. 73) develops the tuberosity which is present in many recent Reptilia as well as in some Mammalia. The lacrymal in the present Dicynodontal skull extends forward about an inch upon the facial plane.

The base of the nasals (ib. 15) is the beginning of the downward slope in the profile view; the breadth of the pair of bones there is 2 inches 8 lines (Plate XXV. 15, 15); they articulate with the frontals (11) by a transverse, with the prefrontals (14) by a longitudinal suture. Beyond this they expand to a breadth of 3 inches 9 lines; and the outer border of each bone projects as a rounded thick ridge (Plate XXV. 15') which overhangs the nostril, *n*, and terminates forward in a low obtuse process. This structure recalls the similar one in *Gorgonops*. The nostril, *n*, of a subtriangular form, with the rounded apex downward, is midway between the orbit and the somewhat mutilated fore end of the premaxillaries (22). Its vertical diameter is 2 inches 7 lines; its longitudinal diameter is 2 inches; the fore border is better defined than the hind one, where the maxillary (21) gradually slopes forward or sinks into the aperture, and seems to reduce the direct communication with the olfactory passage to a subtriangular orifice 1 inch 3 lines in diameter. The tegumentary covering of the infundibular nostril may have been of a valvular construction. The maxillary (21), unites posteriorly with the prefrontal (14), lacrymal (13), nasal (15), and (beneath the orbit) with the malar (26). The development of this bone and of the squamosal (27) is better shown in succeeding specimens. The long squamo-sutural surface, where the malar overlapped and united with the squamosal, is here well shown. The thick-walled socket of the canine is continued downward and forward at least 2 inches below the line of the edentulous alveolar border in front and the vertical plate of the palatine behind.

The canines, where they emerge from the socket, present a circular transverse section (Plate XXIV. *c'*), and, besides continuing the obvious direction of their sockets, are slightly bent inwards, curving towards each other, and reducing the space in which the mandible worked, at the present fractured ends of the tusks, to a breadth of barely 2 inches.

In the type skull, No. S. A. 54, it seems that the lower jaw expanded, gaining or resuming breadth, anterior to the line of its play within or between the crowns of the long tusks, descending outside the rami.

parietale," intervenes between the right and left temporal ridges (t''). The longitudinal extent of the fossa is gained by the backward extension of the lateral portions of the occiput (ib. s'. s'), the halves of

The condition of the maxillo-premaxillary part of the bony palate, and the configuration of the alveolar border of the præmaxilla, cannot be defined in the present fossil.

From "Gats River, in the Sneewberg mountain-range, District of Graaff-Reinet," Cape of Good Hope.

W. Guybon Atherstone, M.D. [P.].

No. S. A. 57. The fore part of a mutilated skull of *Dicynodon leoniceps*, on the palatal surface of which have been exposed the bases of three worn longitudinal ridges. The hinder and median one holds the place where the vomer might appear; the other two are anterior, form a pair, and divide the palatal part of the premaxillary into three longitudinal channels, of which the mid one is the deepest.

This modification has not been observed on the palate of any existing reptile. That of some Lizards (*Monitor niloticus, Varanus varius*, e. g.) has a median longitudinal ridge on the palatal process of the premaxillary, and three similar, but smaller, ridges on that surface of the vomer. The canines in the present fossil have been broken off close to the socket.

A longitudinal section of the implanted base of that on the right side has been made; it is 2 inches in length and 1 in diameter, which is retained to within half an inch of its implanted end, where the tooth begins to contract, but terminates in a truncate end 6 lines in diameter; it is solid throughout; and the cavity of the maxilla above the base shows no trace of a successional tooth. It may be inferred that the present portion of skull has come from an aged individual.

The stratification in thin layers of the matrix in which this fossil has been imbedded is worthy of note.

From triassic deposits, district of Graaff-Reinet, Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 58. The articular end of the right scapula with the coracoid of *Dicynodon leoniceps*. The coracoid exemplifies the broad and short type, with the large "axillary" perforation.

From triassic deposits, district of Graaff-Reinet, Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 59. The proximal half of the right humerus of *Dicynodon leoniceps*: Plate XXVII.

With a vast development of the deltopectoral crest (b, b') an "entepicondylar canal," as in the Theriodontia, is here indicated by the smooth notch or groove, k, at the broken end of the shaft. Other characters of the dicynodontal humerus are shown in No. S. A. 72, from a smaller species. The entire canal is shown in the humerus.

From triassic deposits, district of Graaff-Reinet, Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 60. The left "os innominatum" of *Dicynodon leoniceps*: Plate XXVIII.

The iliac element (62) is an inequilateral triangular plate with one angle produced and thickened to form the upper (iliac) portion of the acetabulum and the articular surfaces for the pubic and ischial elements of

anterior half of the skull; the posterior half is devoted to the cranial cavity and the temporal fossæ. The length of the upper aperture of the fossa (Plate XXV. *t*, *t*) is 8 inches; if the mastoid part of the

the compound bone, which surfaces are here obliterated by bony union. The anterior or inner border of the ilium is the longest and thickest; it is nearly straight. The posterior or outer border is the shortest, is concave, and gains thickness as it approaches the acetabulum. The upper (neural) border thins off to an edge between the sacro-iliac symphysis and the posterior angle. This symphysis, long and narrow, limited to the fore part of the inner surface of the ilium, is divided by a thick longitudinal ridge into two facets, meeting there at an open angle. Only the thick, transversely convex, anterior border extends, in that direction, beyond this articular surface; in the opposite direction the inner surface of the ilium extends 5 inches to the posterior angle; but this part of the iliac surface is grooved and ridged along great part of its extent. The outer free surface of the ilium is smooth and flat, save where relieved by the thickening of the fore and hind borders.

The pubic element is indicated by its anterior (lower or hæmal) position, and by the retention of the reptilian character of the perforation for the superficial femoral artery. The bone swells out in front of the foramen, and may have developed a "pectineal process," as the surface here shows some abrasion. The ischial element is broader, subquadrate; the upper and hinder angle thickened and produced as a "tuber ischii." The ischio-pubic symphysis forms a large semielliptic surface, 6 inches by $2\frac{1}{2}$ inches. The coalescence of the two (hæmal) pelvic elements leaves no "obturator space or foramen." In this respect the os innominatum of *Dicynodon* shows a structure hitherto unobserved in any vertebrate. The acetabulum has a diameter of 4 inches in the axis of the os innominatum, of 5 inches at right angles thereto; its margin is undulate, being partially produced at the iliac, ischial, and pubic constituents. The total length of this os innominatum in a straight line is 18 inches; its greatest breadth across the confluent pubis and ischium is $8\frac{1}{2}$ inches.

From triassic deposits, district of Graaff-Reinet, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 61. The right femur of *Dicynodon leoniceps*. It has been crushed and the proximal end mutilated. The shaft shows no trace of the "third trochanter," which is present in the femur of certain large vegetarian extinct reptiles.

From triassic deposits, district of Graaff-Reinet, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon Bainii**, Ow.

No. S. A. 62. The skull, wanting the lower jaw.

The species was founded on two portions of skull discovered by the geologist after whom it is named, "the base of a tusk, nearly 2 inches in diameter"†, showing a subelliptical transverse section. The present specimen, from a somewhat smaller individual, shows the same character of tusk, and is therefore referred to that species. It is figured of the natural size in Plate XXIX., and reduced in Plates XXX., XXXI., & XXXII.

This skull includes the temporal fossa (*t*, *t'*), the orbit (*o*), and the external nostril (*n*), of both sides. Like the preceding it is remarkable for the great proportional size of the temporal vacuity, and shows more completely the extent of surface of attachment of the muscle traversing the vacuity for implantation in the lower jaw. This surface impresses the side of the cranium at *t*, but does not extend upon the upper surface; a flattened tract of the parietal (Plate XXVIII. fig. 2, 7), perforated by the "foramen

* Trans. Geol. Soc. vol. vii. 2nd series, p. 76. † Ib. ib.

parietale," intervenes between the right and left temporal ridges (*t''*). The longitudinal extent of the fossa is gained by the backward extension of the lateral portions of the occiput (ib. *s'*, *s'*), the halves of the occipital (parieto-mastoid) crest converging to the parietal (7) at a rather acute angle. The breadth of the temporal fossæ is obtained by the wide span of the zygomatic arches (ib. *t''*, *t''*); the extension in that direction of the surface of attachment of the crotaphyte, or biting, muscles is further gained by the unusual breadth or thickness of the arches themselves. The surface is smooth and undulate, being chiefly and moderately convex, but graduating into concavity at the outer and hinder part of the zygoma. This character is unique in the class Reptilia; its effect, in the action of the muscles to which it gives origin, must have been to cause the deep and powerful, though edentulous, mandible to press with extraordinary force the object seized by the canine tusks against those piercing lethal weapons projecting from above downward.

The upper surface of the cranium rapidly gains breadth in advance of the "foramen parietale," and retains such breadth, with a general flatness, as far as the fracture, which has detached the fore end of the skull in advance of the nostrils, *n*. The contour of this surface, so far, is almost straight. A strong postfrontal bar (Plates XXIX. & XXXI. 12) arches transversely with a slight direction forward, and then descends to meet it and join an ascending process of the malar (26), some part of which is broken away. The orbit, *o*, situated, as in *D. leoniceps*, in the anterior half of the skull, has a subtriangular contour, the apex anterior, and the angles rounded off. The nostril (ib. *n*) is overarched by a thick nasal plate, the free border of which has been broken away.

The tusk, *c*, issues at a vertical parallel with the fore border of the nostril. The tooth, when entire (and its proportions may be estimated from the better-preserved canines of smaller Dicynodonts, especially the type specimen, S. A. 54), has projected rather forward from the vertical line, but with a minor slope than in *D. lacerticeps*.

The occipital surface (Plate XXX. fig. 1, half nat. size) is almost vertical along the mid line, a little bending forward above to the parietal plane. Its sides are rendered deeply concave by the backward extension of the mastoid elements of the superoccipital crest. The breadth of the occiput is more than twice the height of that surface. The mass of muscle therein inserted may have related to overcoming the resistance of a struggling prey pierced by the canines and held in the strong grip of the mandible. The specific distinction between the present species and *Dicynodon leoniceps* is obvious in the comparison of the cranial surfaces figured in Plate XXX. fig. 1 and Plate XXV.

The basioccipital extends some way vertically below the condyle (here broken off), and sends down a pair of basioccipital processes (1', 1'), common to the genus. External to these the paroccipitals descend still lower, augmenting the vertical extent of the occiput, and affording leverage to the attached muscles.

At the base of the skull (Plate XXXII. fig. 2) a deep cleft leads between the processes (1', 1') to the narrow basioccipital surface, which expands in advance of those processes into a subquadrate basisphenoid. This is continued forward by the coalesced part of the pterygoids (24), from the outer and fore angles of which diverge the pterygoid boundaries (24') of the palatonaris. These are strong rounded bony bars (24'), but soon unite with the palatines (20), which expand as they advance to join the maxillaries (21) and carry forward and outward the abutments diverging from the basisphenoid and coalesced pterygoids to strengthen the sockets of the canines. The palatal and maxillary parts of the roof of the mouth have suffered mutilation in the present specimen.

From triassic deposits at Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon tigriceps**, Ow.

No. S. A. 63. The skull, wanting the lower jaw.

A side view (Plate XXXIII.), corresponding with that (Plate XXIX.) of the previous specimen, is here given, of the natural size, for the purpose of comparison.

The skull of *Dicynodon tigriceps* differs from that of its equal in bulk (*Dicynodon Bainii*) in the form of the orbit (*o*), of the temporal fossa (*t*, *t'*), in the relative position of the outer nostrils (*n*), and in the direction of the alveoli of the canines, and consequently of those formidable weapons themselves. With the circular cross section of the canine (*c'*) is associated a more vertical direction of the tooth, with a position of the socket nearer to the orbit; so that the outlet of the socket and the base of the canine are on a vertical line with the hind part of the nostril, and between it and the orbit.

A vertical line dropped from the fore border of the orbit, the upper plane of the skull being horizontal, falls, in *Dicynodon tigriceps*, 1 inch behind the exserted base of the canine; in *Dicynodon Bainii* the same line falls 2 inches behind the tooth. The canine in *D. leoniceps* is relatively smaller and less vertically directed than in *D. tigriceps*, and the orbit has a very different form; its hind border inclines rather forward than backward as it descends. The fore end of the skull has suffered more or less mutilation, as in S. A. 56 & 63; but the thickness of the fractured end in the present example indicates a longer rostrum to have characterized *Dicynodon tigriceps* than *D. Bainii* or *D. leoniceps*. The external nostril is overhung by a bony roof in all the species; but the nasal penthouse is thicker, more tuberous, and more extensive in *Dicynodon tigriceps*. The orbit in this species is an inequilateral triangle, with the angles rounded off and the apex behind; the longest diameter (4 inches) is oblique from above downward and backward. The postorbital bar is similarly directed; it is thick and subquadrate, 1 inch 3 lines across at its upper half, expanding to 2 inches 3 lines where it blends with the zygoma; the length of the bar at its outer border is 6 inches. In *Dicynodon Bainii* the same admeasurement of the postorbital bar is 4 inches.

The temporal fossa is large and subquadrate in both species; the surface for the origin of the crotaphyte muscles is immense. The ridge defining the upper border, beginning at the postfrontal, curves backward along the parietal, overhanging the crotaphyte surface on that bone. Thence it runs backward and outward in *Dicynodon tigriceps*, bending with a gentle curve, convex outward, to the external angle of the superoccipital ridge. Here the crotaphyte ridge turns at a rather acute angle outward and forward, forming the boundary between the upper (horizontal) and outer (vertical) surfaces of the enormously expanded zygoma. The upper surface of this singular feature of the skull is smooth and undulate, the convexities, though low, predominating, as in *Dicynodon Bainii*. The breadth of this (upper) surface, at the middle of the postorbital part of the zygoma, is 3 inches; the length from the occipito-mastoid angle to the hind border of the orbit is 10 inches; the breadth of the temporal fossa across its middle is 8 inches 6 lines. Such was the mass of muscle working the mandible in the vertical or biting movements.

The configuration of the zygoma and temporal fossa is best preserved and worked out in the right side of the skull in *Dicynodon tigriceps*, and on the left side in *D. Bainii*; they were essentially alike in extent, configuration, and structure. After a comparison carried out through all the reptilian skulls thereto available, I find the nearest approach, though the interval is considerable, to the above Dicynodontal character in the chelonian genus *Chelydra*.

On the occipital surface (Plate XXX. fig. 2) of *Dicynodon tigriceps*, the condyle (1), as well as the hypapophyses (1', 1') of the basioccipital, are preserved. The occipital foramen shows the same vertically narrow form as in *D. Bainii* (ib. fig. 1) and *D. lacerticeps* (Plate XXII. fig. 3). The general aspect, proportions, and undulations of the occipital surface are repeated, together with the intermuscular ridge (*r*) on the paroccipital (4). The broad type of the occipital surface is better shown than in the somewhat crushed specimen of *Dicynodon leoniceps*.

* Trans. Geol. Soc. vol. vii. 2nd series, 4to, p. 233 (1855).

* Trans. Geol. Soc. vol. vii. 2nd series, p. 76. † Ib. ib.

On the palatal surface (Plate XXXII. fig. 1) the intercanine extent of ossification is preserved; the median *quasi* vomerine ridge (13) is shown, and parts of an anterior pair of premaxillary ridges (22′, 22′) also appear along its fore part, repeating the structure in S. A. 57. The "palatonaris" (*n*), or interpalatal vacuity, is defined anteriorly, as in *Dicynodon leoniceps*; but the hinder part is interpterygoid. The processes answering to 24* in Plate XXVI. could not be satisfactorily made out in the present specimen.

The basioccipital (1), between its processes (1′, 1′), is markedly broader than in *Dicynodon Bainii* or *D. leoniceps.*

From the triassic deposits at the Gonzia river, Kaffraria.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 64. The fore part of the mandible of *Dicynodon tigriceps,* including the symphysis.

The latter part is 7 inches in depth, following the curve, although a portion is wanting from the apex above and from the base below. Its outer and fore surface is traversed by a median obtuse ridge. The alveolar border in each ramus shows an inner ridge or rising, slightly convex lengthwise, separated by a narrow groove from a lower outer ridge. No trace of teeth is present here or at the anterior fracture of the apex of the symphysis. A strong longitudinal obtuse ridge begins to project from the outer side of the ramus, 4 inches from the fractured fore end of the jaw, and an inch below the alveolar border. The dentary element is notched below the hind fractured part of this ridge, indicative of a vacuity in the outer plate, at least, of the dentary, the hinder fractured surface of which shows its division by a vertical fissure for junction with the hinder elements of the compound jaw-bone. The anterior ends of the "splenial" unite to enter into the formation of the hind and under part of the symphysis.

From the triassic deposits at Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 65. A block of triassic matrix, including a mutilated skull, with the mandible, of *Dicynodon tigriceps*: Plate XXXIV. fig. 1, half nat. size.

The right maxillo-zygomatic wall of the skull is broken away from the fore part of the orbit to the tympanic pedicle. The prominent fore and under part of the orbit, due to the combined maxillary and lacrymal, is underpropped by the palatine (Plate XXXIV. fig. 1, 20), the hinder border of which is joined by an extensive, largely angular suture with the pterygoid (ib. 24). The upper anterior angle of the pterygoid joins also the anterior extension of a cranial bone, which may be homologized with either the presphenoid (as in Crocodilia) or with the orbito-sphenoid (as in Chelonia). This plate of bone, with the descending plate from the frontal or postfrontal (ib. *o*), shows the interorbital space to have been more completely ossified than in modern Crocodilia, Chelonia, or Lacertilia. It is another approximation in these South-African reptiles to a higher, *quasi* mammalian condition of cranial structure. From the "basisphenoid" extends downward and outward a plate (5′) representing the pterapophysis in Lizards; and to this the portion of the pterygoid (ib. 24) is articulatnd, which then descends outwards and backwards to abut against the débris of the tympanic. The inner part of the joint of the tympanic (28) and articular (29) is preserved. The latter element of the mandibular ramus is continued forward as the subangular (29). A part of the deep angular (30) is preserved, and the hinder articulation, with both elements of the dentary piece (32), is well shown. The symphysial part of the splenial (31) is indicated; but the outer wall of all this part of the ramus has been broken away. Beyond the débris of the tympanic and paroccipital the left half of the condylar process (1′) of the basioccipital projects, and the left side of the broad, high, and well-ossified occipital surface of the skull is preserved. This has been pressed backward out of position by posthumous movement of the matrix; the foramen magnum is consequently narrowed. One of the basioccipital processes (1′) is preserved; the parial division of these

is repeated in Lacertilia; but the processes may be represented as coalesced to form the broad, descending, basioccipital plate in Crocodilia; this character is lost in Chelonia.

The base of the socket and corresponding part of the canine, *c*, are shown in the débris of the maxillary bone. On the opposite side of this specimen a vertebra is exposed, showing the deeply cupped hinder articular surface of the centrum. The parapophysis projects from the upper part of the side of the centrum near the fore articular surface. A diapophysis extends from the base of the neural arch, indicative of the position of the bone in the dorsal region of the vertebral column. The neural spine, zygapophyses, and base of the diapophysis of a contiguous vertebra are also exposed.

From the triassic deposits, or Karoo beds, in the district of Graaff-Reinet, South Africa. His Royal Highness the Duke of Edinburgh, K.G.* [P.].

No. S. A. 66. A series of eight anterior dorsal vertebræ, with portions of ribs, a scapula, humerus, radius, and proximal portion of the ulna of the right side of *Dicynodon tigriceps*: Plate XXXV.

The vertebræ have centrums expanded at the ends and subcompressed or concave lengthwise. The neural arches are lofty, and expand into a platform sustained by a strong buttress, inclined forward and developing the diapophysial articulation for the tubercle of the rib; the neural spines are strong, thick, and inclined backward. In the anterior of these vertebræ the parapophysis for the capitular process of the rib has not wholly risen above the centrum. The vertical longitudinal section of the two anterior of these vertebræ exposes the biconcave character of their centrical articulations.

The scapula, in part hidden by its limb-bones, is elongate, subcompressed, 3 inches in breadth above the humeral expansion, which gains 6 inches where it supports the articular facets for the humerus and coracoid.

The humerus, 1 foot 2 inches 4 lines in length, presents its anconal surface to view. The base of the delto-pectoral crest has an extent of 8 inches; the crest itself has been broken away at its bend thenad. The base of the thick ulnar tuberous crest shows an extent of $4\frac{1}{2}$ inches. The short twisted shaft between the proximal and distal expansions is subtrihedral, the anconal facet showing a breadth of $2\frac{1}{2}$ inches; the breadth of the distal end seems to have reached 8 inches: traces of the entepicondylar canal are discernible at *i*, *k*, in Plate XXXV. It has not the ectepicondylar canal as in certain lizards and other existing Reptilia†. The characteristics of the dicynodontal humerus will be seen in the better-preserved specimens of smaller species of the family.

The radius, 9 inches in length, has the proximal surfaces for the humerus and the ulna more equal and better marked than in recent reptiles; the breadth of both ends is alike, viz. 3 inches 8 lines; that of the shaft is 2 inches 9 lines. The ulna has a thickly obtuse, but well-marked, acromial production, with a breadth of 3 inches 9 lines, that of the middle of the shaft being 1 inch 9 lines.

From triassic deposits at the Gonzia river, Kaffraria.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 67. The pelvis of *Dicynodon tigriceps*: Plates XXXVI. & XXXVII., $\frac{3}{8}$ nat. size.

Along the inferior or hæmal surface of this pelvis (Plate XXXVI. fig 1) six successive vertebræ, and part of a seventh, are seen. A slight dislocation of the foremost, L, at its articulation with the second (*s*, 1) indicates them not to have been anchylosed together; and the portion of the long and comparatively slender rib (ib. L, *pl.*) articulated to the diapophysis of the foremost vertebra shows it to have been the last of the reciprocally movable trunk-vertebræ. In relation to the sacrum it would be "lumbar;" but by the rib-character it is dorsal.

* Philosophical Transactions, 1862, p. 459.

† *Trionyx*, e.g., Descr. Catal. of the Osteology in the Museum of the Royal College of Surgeons, 4to, 1853, p. 184, nos. 942, 943; *Monitor niloticus*, Monogr. on *Omosaurus armatus*, pl. xvii. fig. 6, *e'*

The six following vertebræ (*s* 1-6) have coalesced; but traces of the intervertebral articulations remain; their neural spines are short, thick, rounded, not continuous and coalescent as a sacral crest (fig. 3, *ns* 1, *ns* 2). The first sacral (*s* 1) is characterized by the great terminal expansion of its rib-element (*pl.* 1), which overlaps, or passes hæmad of, the iliac bone (fig. 1, 62). The inner or hinder border of the rib (that next the cavity, and contributing to form the "brim," of the pelvis) is thick and smoothly rounded. The opposite border is thin. The outer part of the terminal expansion (*t t*) has suffered fracture; it seems, from its condition on the left side, to have been nearly straight; it has not coalesced with the ilium. This bone together with the ischial (64) and pubic (63) elements of the "os innominatum" have coalesced, as in mammals, into one bone. The pubis shows Lacertian and Chelonian characters in contributing a small proportion to the acetabulum and in the "superficial femoral-arterial perforation"* (Plate XXXVI. fig. 1, *p*).

The symphysis pubis (ib. *s* 63, Plate XXXVII. fig. 2, 63′) is obliterated by bony confluence; and this is continued backward to a similarly confluent ischial symphysis (ib. 64′). The obturator space would thus have been, as in mammals, divided into a pair of large foramina; but these also have been obliterated by progressive ossification, as shown in Plate XXXVIII. fig. 2, *o, o*. The ilium, in its extension forward from the acetabulum, repeats a mammalian character; but in its relations to the last lumbar and first sacral ribs it recalls certain characters of the ilium in the pelvis of birds. The ribs of the second and third sacrals abut against the ilium, those of the fifth and sixth sacrals against the ischium, dividing the great "ischiadic notch," as in edentate mammals, into two foramina.

The following may be cited among the principal contributions to pelvic modifications in the air-breathing vertebrate series which the present part of the skeleton of *Dicynodon* affords. It is articulated anteriorly, as in birds, to a vertebra having the anthropotomical characters of a dorsal one, *i. e.* to a vertebra supporting a pair of long and free ribs.

There are six sacral vertebræ by the character of anchylosis, of which the first is joined to the innominate bones by a squamous syndesmosis of a pair of expanded pleurapophyses, overlapped by the ilia.

These bones coalesce with the ischium and pubis to form an "os innominatum," as in birds and mammals; the ischio-pubic symphysis is continuous, as in mammals; the ilium is not continued backward beyond the acetabulum as in birds and reptiles, nor both backward and forward as in Crocodilia, Pterosauria, and Dinosauria, but forward almost exclusively, as in mammals.

From the triassic deposits at "East Brak River," Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 68. The first and second sacral vertebræ of *Dicynodon tigriceps*†. This specimen is figured, $\frac{3}{8}$ nat. size, in Plate XXXVI. figs. 2 & 3.

Combined di- and parapophyses, coalesced with almost the entire longitudinal extent of the centrum and neural arch of the first sacral vertebra (fig. 3, *d*), give anchylosed attachment to the head and tubercle of the rib (ib. *pl.* 1). This rib, for an outward extent of about 2 inches, is subdepressed, with the fore and hind borders concave; it then rapidly expands: the fore part of the expanse is not quite entire; the hind part (*pl.* 1′) is continued abruptly backward, parallel with the long axis of the sacrum, and underlies the expanded end of the thicker and narrower rib (*pl.* 2) of the second sacral vertebra. An extensive syndesmosal surface (Plate XXXII. fig. 2) for abutment against the ilium is thus formed, the hæmal surface of that bone, viewed from that aspect, being covered, and seemingly underlapped, by the anomalously expanded first sacral rib (ib. fig. 1, *pl.* 1).

The zygapophysial joints between the two sacrals are plainly traceable, though they are immovably

* Figured by Cuvier, in the Monitor Lizard, in the 'Ossemens Fossiles,' tom. v. pt. 2, plate xvii. fig. 39, *b*.
† Trans. Geol. Soc. 2nd series, vol. vii. (1855), pl. xxxiii. figs. 4 & 5.

united by extensive confluence of other parts. The neural spine of the second sacral (fig. 3, *ns* 2) projects freely, is short, thick, terminally expanded, and rather flattened at top.

From triassic deposits of the district of "Graaf Reinet," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 69. Two succeeding vertebræ, apparently the same sacrum, of *Dicynodon tigriceps*.

This specimen shows the short, thick, rounded, and obtusely terminated neural spines, with the terminally expanded and united distal ends of the right pleurapophyses, showing their somewhat flattened rough articular surface for abutment against the os innominatum. The neural arch maintains its normal relations to the centrum, as in the preceding specimen. In the original memoir on *Dicynodon tigriceps** the two sacral fossils were stated to be, "respectively, either the entire sacrum of two distinct species, according to the analogy of existing Reptilia, or parts of the same sacrum;" and reasons are assigned (p. 244) for concluding them to be the anterior and posterior parts of the same sacrum, or of the sacrum of the same species of reptile. The subsequent acquisition of the specimen No. S. A. 67 (Plate XXXVI. fig. 1) confirms that conclusion; and as No. S. A. 68 could not be made to fit No. S. A. 69, it was inferred that "there may be more than four vertebræ in the sacrum of the *Dicynodon*"†.

From triassic deposits of the district of "Graaf Reinet," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon pardiceps*, Ow.

No. S. A. 70. The skull, wanting the lower jaw; figured, of the natural size, in Plate XXXVIII., and half nat. size in Plate XXXIX.

This species differs from *Dicynodon leoniceps* (Plate XXIV.) in the shape of the orbit and the minor slope from that cavity to the nostril. It resembles *Dicynodon tigriceps* in the direction of the postorbital bar (Plate XXXVIII. fig. 1, 12, 26), and resembles *Dicynodon Bainii* in the anterior direction of the apex of the subtriangular orbit, *o*; but it differs from both these species, not only by inferiority of size, but by other characters, the chief of which may be briefly noted. The skull is narrower in proportion to its length; and this is chiefly due to a minor expanse and less horizontal direction of the zygomatic surface affording origin to the temporal muscle; hence in the direct side view, as in Plate XXXVIII., the inferior surface of the zygoma is seen instead of the superior surface, as in Plates XXIX. & XXXIII. The orbit is more elongate, and terminates forward in a point. The nostril (*n*) appears to have its long axis directed forward and slightly upward. The socket of the canine is intermediate to that in *D. tigriceps* and *D. Bainii*, in its relative position to the orbit and nasal cavities. The occipital condyle (Plate XXXVIII. fig. 2, 1) has a subtriangular form, and, relatively to the occiput, is larger than in *Dicynodon tigriceps*. The superoccipital ridge, due to the parietals and mastoids, forms, as in *D. lacerticeps*, a right angle, with the apex upward.

The specific characters of *Dicynodon pardiceps*, in the present comparison, is also strongly brought out in the upper view of the skull (compare fig. 1, Plate XXXIX., with figs. 1 & 2, Plate XXXI.). Although a greater proportion of the fore part of the skull is preserved in the present smaller species, the inferiority in relative size and expanse of temporal fossæ (*t*) is not affected. On the lower surface of the skull (ib. fig. 2) the configuration of the bony palate is better given in the present than in preceding fossils. The premaxillary portion is divided by a pair of parallel ridges (22′) into three longitudinal imperforate

* Trans. Geol. Soc. 2nd series, vol. vii. (1855) p. 244. † Ib. ib.

The original, obtained from triassic deposits at Cradock, Elandsberg, South Africa, was

fossæ. The vomer (13) extends from the middle fossa backward to the interpalatal vacuities (*p*, *p*). Into these vacuities the median anterior processes (24*, 24*) of the coalesced pterygoids (24) extend forward as in S. A. 56, converge, unite, and divide what may be an interpterygoid palatonaris (*pn*) from the interpalatal vacuities (*p*, *p*). The canine (Plate XXXVIII. *c'*) has an elliptic transverse section. The arch of the bony palate between the alveolar borders of the maxillaries is more concave or deeper than in the previous larger species of *Dicynodon*. The matrix in which this skull was found is of less hardness and of a lighter colour than that of most of the reptilian fossils from South Africa.

From triassic (?) deposits near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 71. A dorsal vertebra of *Dicynodon pardiceps*: Plate LIII. figs. 2, 3, 4. The amphicœlian centrum (fig. 4), parapophysis (*p*), diapophysis (*d*), and lofty buttressed neural arch (*a*, *b*), characteristic of the Anomodontia, are well exemplified in this vertebra.

From triassic deposits near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 72. The left humerus of *Dicynodon pardiceps*: Plates XLI. and XLII.

This bone is remarkable for the extent of the delto-pectoral crest (*b*, *b'*) and the degree of its extension thenad and ulnad, still more so for the perforation (*h*, *k*) above the inner or ulnar condyle.

The proximal articular surface (Plate XLI. fig. 2, *a*), with the usual production and convexity anconad (Plate XLII. fig. 1, *a*), preserves beyond this part its breadth to the ulnar tuberosity (Plate XLI. fig. 1, *c*), which is continued as a thick thenal angle of the ulnar side of the shaft straight down to the beginning of the entepicondylar ridge (*f'*). The radial tuberosity (*b*) or beginning of the delto-pectoral crest, extends thenad, broadening to the angle (*b'*), then, subsiding, is continued to the bridge (*h*), which defines the entepicondylar canal (*k*); in a direct anconal view of the bone, as in fig. 1, Plate XLII., the canal so crossed is not seen.

In the direct thenal view (as in fig. 1, Plate XLI.) the proximal half of that surface of the humerus is a wide and deep depression between the ulnar deflected tuberosity (*c*) and the delto-pectoral crest, the angle of which (*b'*) is bent almost to the ulnar side of the shaft. Below the angle the crest inclines ulnad as it descends toward the entepicondyle, and in this course (*h*) is perforated, as in placental Carnivora and most Marsupialia, by a canal for the passage of a nerve and artery. The outlets of the canal (*k*) are elliptical, 1 inch by $\frac{1}{2}$ an inch in diameter; from the lower border of the outlet to the distal end of the humerus is 2 inches 9 lines.

The thenal part of the ulnar condyle (*f*) is broken away. The radial condyle (*g*), chiefly extended thenad, is entire. There is no trace of the ectepicondylar or supinator crest, as in *Pareiasaurus* (Plate XII. *e*, *e'*) and *Cynodracon* (Plate XVIII., *e*, *e*), nor of the ectepicondylar canal which characterizes the humerus in certain Chelonia and Lacertilia. An ectepicondylar tuberosity (*e'*) has suffered abrasion.

This humerus has a length of 9 inches, an extreme breadth (at the distal end) of 5 inches 6 lines (probably rather more when entire); the least circumference is 7 inches.

From triassic deposits near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

united by extensive confluence of other parts. The neural spine of the second sacral (fig. 3, *ns* 2) projects

Species *Dicynodon rectidens*, Ow.

No. S. A. 73. The fore part of the skull, with the corresponding portion of the mandible. Two views are given, of the natural size, in Plate XL.

The upper jaw has suffered crushing and dislocation, but not such as to have artificially produced the vertical direction of the sockets of the canines (Plate XL. fig. 1, *c*). The transverse section of these teeth is circular (ib. fig. 2, *c*, *c*), not elliptical as in *Dicynodon pardiceps*, which the present species resembles in size. The edentulous border of the premaxillary part of the upper jaw is indicated at 22. The outer surface of the deep and narrow symphysis of the mandible (ib. fig. 2, 32) is entire; it shows the division into three, equal, transversely convex tracts by the parallel pair of longitudinal grooves, and the expansion of the sides forming the ridge (*r*) beyond the part included between the two upper canines (*c*, *c*) when the mouth is closed. The trenchant character of the upper and anterior border of the lower jaw is well displayed. The depression or notch (ib. fig. 1, *v*) below the ridge (*r*) in the dentary is well marked in the present species.

From triassic deposits near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 74. A series of five dorsal vertebræ of *Dicynodon rectidens*, of two of which a section has been made showing the concavity of the articular ends of the centrum: Plate XXXV. fig. 3.

The free surface of the centrum is concave lengthwise. The parapophysis has risen to near the base of the neural arch. The pleurapophysis extends its articular surface therefrom to the diapophysis without the anterior notch dividing a "capitular" from a "tubercular" process; the proximal part of the rib thus presents the form of a triangular plate, from which the body of the rib begins as a ridge of the outer surface. These portions of ribs have, at first sight, the aspect of dermal scutes; but no clear evidence of such, in any Anomodont, has hitherto come under the cognizance of the describer.

From triassic deposits near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon curvatus*, Ow.

No. S. A. 75. A cast of the skull, wanting the lower jaw.

This specimen, though with much loss of the outer surface of the bone, demonstrates proportions which determine its specific distinction. With an orbit as large as in *Dicynodon pardiceps*, and of greater anterior vertical extent, it had a temporal fossa of only half the longitudinal extent. The basioccipital condyle and hypapophyses are relatively longer. The orbits open upon the middle third of the skull, as in *D. lacerticeps*. The socket of the canine slopes forward from beneath the fore and under part of the orbit, and has its outlet beneath the fore part of the nostril. This opens midway between the orbit and the fore end of the skull. The upper profile has a stronger and more regular convex curve than in other Dicynodonts; but this character might be less marked in more perfect specimens. A careful removal of matrix from the "basis cranii" shows a slight convexity of the confluent part or platform of the pterygoids, the slender boundaries of the "palatonaris," the thicker processes joining the palatine boundaries of the interpalatal vacuity, and the hinder part of the vomerine ridge.

The original, obtained from triassic deposits at Cradock, Elandsberg, South Africa, was transmitted for the purpose of the above determination and description, and with permission to take a cast, by

Professor John Morris, F.G.S., of University College, London.

Species *Dicynodon feliceps*, Ow.

No. S. A. 76. The skull with the lower jaw: Plate XLIII.

The similarity of state of conservation of the present specimen with the type fossil of the genus (S. A. 54) affords satisfactory ground of comparison. This shows the "cat-headed" species to be of smaller size than the lizard-headed one. But the facial part of the skull anterior to the orbit is relatively shorter, and the canine tusk curves down rather more toward the vertical direction. The occiput (Plate XLIII. fig. 3) is broader in proportion to its height, the angle of the superoccipital (parieto-mastoid) ridge is lower or more obtuse. The temporal muscular impressions meet upon the parietal, as in *D. lacerticeps*, indicating equal maturity in the smaller species; there is also a "foramen parietale" (ib. fig. 2, 7). The frontals (ib. 11) and nasals (ib. 15) are relatively broader than in *D. lacerticeps*. The orbit (ib. fig. 1, *o*) inclines to the triangular shape with the base behind. A greater proportion of the edentulous premaxillary (fig. 1, 22) is preserved in this skull than in the type specimen.

The mandibular rami meet at a more open angle (ib. fig. 4) than in *D. lacerticeps*. A section of the tusk made on the right, more mutilated, side of the skull shows the length of the pulp-cavity (*c*, fig. 6); but the seeming obliteration near the base is due to the obliquity of the section. The ramus of the mandible (ib. fig. 1, *v*) is deeper in proportion to its length than in *D. lacerticeps*. The specific destinctness of *Dicynodon feliceps* is thus well established; and the same conclusion in relation to *D. leoniceps* is supported by the condition of the temporal fossæ (ib. fig. 2, *t*, 7).

From a triassic deposit in the basin of Fort Beaufort, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon testudiceps**, Ow.

No. S. A. 77. The anterior two thirds of the skull, without the lower jaw: Plate XLIV. figs. 1, 2, 3.

This portion includes the orbits (*o*), nostrils (*n*), and bony palate (fig. 2); the latter shows the vacuity circumscribed by the vomer (13) anteriorly, and the palatines (20) and pterygoids (24) laterally and behind. The nostrils are relatively larger than in *D. feliceps*; and the premaxillary (22) curves more abruptly downward to its edentulous border, which is here well preserved. It resembles *D. feliceps* in the length of the antorbital part of the skull, but markedly differs in the greater relative breadth of that part and in the backward position of the socket of the canine tusk, which tooth projects in the same vertical line with that of the fore part of the orbit, and is continued downward posterior to the nostril. The orbit appears to have been relatively smaller than in *D. feliceps*, and consequently much smaller than in *D. lacerticeps*, indicative of the smaller eyes of the present species; the hind boundary of the orbit has been broken away.

In size the present species must have equalled the *Dicynodon lacerticeps*; but the breadth and shortness of the fore part of the skull, the sudden convex declivity of the rostral termination, and the sharp, vertical, edentulous border of the wide premaxillary are features of resemblance to the skull of a Tortoise, and

* Trans. Geol. Soc. 2nd series, vol. vii. p. 71 (January 1845).

have suggested its specific name. The mid part of the premaxillary edentulous border is strengthened, on the palatal surface, by two short and narrow buttresses of bone (22*), dividing that part into a deep and narrow median depression and two wide and shallow lateral ones. These are bounded behind by the inward prominence of the sockets of the great maxillary tusks. About an inch behind the premaxillary margin begins a longitudinal ridge, which is continued backward along the mid line of the bony palate for an inch and a half. This ridge, which I refer to the vomer, is developed between the right and left sockets of the canine tusk, and adds strength and resistance to the arch of bone which spans from one socket to the other, as similar appendages of an arched roof are introduced to give it additional strength as well as ornament. There is a shallow longitudinal depression on each side of the fore part of the interpalatal vacuity: these depressions are less deep than in *Dicynodon pardiceps*, but are entire, or imperforate, as in that and other species of the genus. There is no other opening, save the interpalatal, on the extent of the bony palate here preserved. The confluent parts of the pterygoids are wanting.

From a triassic formation in the "Tacka prolongation of the Winterberg range of mountains," Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon recurvidens*, Ow.

No. S. A. 78. An obliquely crushed skull, of which two views are given, of the natural size, in Plate LXIX. figs. 3 & 4.

The present fossil strikingly exemplifies the effect of slow and continuous pressure upon a complex bone supported at all points by the moving matrix. It thus becomes bent and twisted; parts are singularly dislocated without fracture; and the forces would seem to have operated on a plastic body. Careful and experienced chiselling is essential to relieving, with an entire superficies, from the dense matrix so much of the skull as is here displayed. The head of the reptile has been imbedded with the lower jaw naturally articulated.

The orbit (*o*) is wholly in the anterior half of the skull; its border appears to have been somewhat prominent. The elongate suboval form of the cavity has been exaggerated by, if it be not wholly due to posthumous pressure. The canine (*c*) projects below the middle of the orbit; it is short, recurved, conical, relatively smaller than in unquestionably mature specimens, and probably indicative of the immaturity of this small Dicynodon. The zygomatic arches are accidentally wanting.

The symphysis mandibulæ is long, rather narrow, with an obtusely convex trenchant fore border. The apex of the coronoid process rises in advance of the midlength of the ramus, augmenting the leverage-power of the large crotaphyte muscles.

From triassic deposits near Fort Beaufort, South Africa.

Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon dubius*, Ow.

No. S. A. 79. The skull, somewhat mutilated, with the mandible naturally articulated. It is figured, of the natural size, in Plate LXIX. figs. 1 & 2.

The occipital surface, from which the retroverted marginal parieto-mastoid crests have been broken away, repeats the vertically oblong form of the "foramen magnum," and rises with a slight forward inclination to the superoccipital apex, the shape of the surface being an almost equilateral triangle. The temporal fossæ are divided by an interval of about three lines, above the parietal, behind the large pineal foramen (*7'*). The boundary bar between the fossa (*t*) and the orbit (*o*) is wanting, probably by accidental

meet above the foramen magnum. The broad plate of bone which they together form is emarginate

violence, on both sides. The postfrontal (12) on the right side, which is best preserved, shows a fractured end. A transverse fracture across the interorbital part of the frontal, with a depression at that part, indicates that the skull, anterior to the fracture, had been somewhat bent upward and the upper jaw pushed in advance of the lower. But the matrix has been petrified about the skull subsequent to such fracture and dislocation. The orbits are relatively smaller than in *Dicynodon lacerticeps*; and the nostrils (*n*) are relatively smaller than in *Dicynodon testudiceps*, the orbits in which resemble in size, shape, and position those of the present species. But this more markedly differed from both the foregoing small Dicynodonts in the apparent absence of canines.

The mandible (30, 32) shows the usual dicynodontal shape, vertically narrowest behind, at its junction with the tympanic; beyond which the angle seems to have been produced but a short way. As the ramus advances the surangular (31) rises to join the upper hinder branch of the dentary (32), forming a low coronoid process; the angular (30) joins the lower branch of the dentary to complete the boundary of the vacuity. From this junction the mandible continues of uniform depth to the hind border of the symphysis, where the jaw gains its greatest depth or height, rising to a beak-like termination and becoming transversely narrower as it rises (fig. 2, *s*). A middle convex tract, as in No. S. A. 74, along the outer or fore part of the symphysial end of the jaw is barely indicated.

The usual test of transverse section of the caniniform production of the maxillary alveolar border was applied; and the presence, in each, of a diminutive canine was thus demonstrated (fig. 2, *c*, *c*). That in the right maxilla showed a full elliptic transverse section of 5 millimetres, or $2\frac{1}{2}$ lines, in long diameter; that on the left side yielded only 3 millimetres in the same dimensions. On the supposition that this small skull might also be one of a young Dicynodont, a longitudinal section was made of the alveolus of the left small canine, which tooth was then seen to suddenly or rapidly expand to typical dicynodontal dimensions, the large pulp-cavity (fig. 1, *c*) demonstrating its germinal character and the nonage of the individual. To what larger known species, if to any, this young skull may be referred, I am in doubt.

From the reddish (triassic?) sandstone, "District of Graaf-Reinet."
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Dicynodon leoniceps**.

No. S. A. 80. Part of a block of matrix, showing the anterior end of the skull.

The incurved direction of the tusks, exemplified in S. A. 56, seems here to be exaggerated; but the appearance is in part due to fracture of both tusks, with some yielding, in the direction of their curve, of the broken ends, prior, as it seems, to complete petrifaction of skull and matrix; whereby they have been preserved in the position revealed by chiselling away the stone. This does not effervesce on application of acid, is chiefly quartzose, and "strikes fire" at each stroke of the chisel.

From "Gats River, in the Sneewberg mountain-range, District of Graaf-Reinet," Cape of Good Hope.
W. Guybon Atherstone, M.D. [P.].

No. S. A. 81. A mass of the same block of matrix as the preceding specimen, exposing portions of a dorsal vertebra and the inner surface of the right scapula of the same individual, *Dicynodon leoniceps*.

The scapula (Plate LXX.) expands to its upper free border, or base (*a*), forming a broader plate

* The block of matrix out of which Nos. S. A. 80 & 81 have been developed was received since Sheets E and F were printed off.

have suggested its specific name. The mid part of the premaxillary edentulous border is strengthened,

than in existing Reptilia, and shows a more marked resemblance to that bone in Mammalia by sending off a distinct acromial process (*e*), as in the Monotremes, from the fore border, a short way above the articular end of the bone (*f*). The scapula is slightly bent, with the inner surface concave toward the trunk. The basal breadth, in the present specimen, is 5 inches. The posterior border or "costa" (*c*) is concave, deeper toward the articular end of the bone. The anterior border or "costa" (*b*) describes a sigmoid curve, convex from the base, then concave, reducing the breadth of the scapula to 1 inch 6 lines, which again expands as the costa curves forward in forming the acromial process (*e*). This expands and is truncate at the extremity, which articulates with a broad flat bone (*n*), in shape resembling rather the "epicoracoid" in Monotromes than a clavicle. The acromion is divided by a short notch from the articular end of the scapula, which gains in thickness as well as breadth, and shows the coracoidal (*f*) and humeral (*d*) facets. The articulated end of the "precoracoid" (*n*) shows part of the scapulo-coracoid perforation (*o*).

From "Gats River, in the Sneewberg mountain-range, District of Graaf Reinet," Cape of Good Hope.

W. Guybon Atherstone, M.D. [P.].

Genus Ptychognathus*, Ow.

Char. The fronto-parietal plane of the skull (Plate XLV. fig. 1, *f–p*) meets the fronto-nasal plane (ib. ib. *f–n*) at a more or less open angle; a ridged character prevails on the exterior of the skull.

Species *Ptychognathus declivis*†, Ow.

No. S. A. 82. The skull, wanting the lower jaw: Plates XLV. & XLVI. fig. 1.

The trivial name of this species is based on the assumption of the horizontality of the fronto-parietal plane (Plate XLV. fig. 1, *p–f*) in the natural position of the head, which would give a correspondingly greater slope to the fronto-nasal plane (ib. ib. *f–n*) than in the position shown in the profile view of the skull in the figure referred to. But this is not the only angle in the profile of the skull of *Ptychognathus*. The occipital plane (ib. fig. 1, *p–o*) meets the fronto-parietal one at an angle which is acute, this plane being almost parallel with the fronto-nasal plane, rising, when the fronto-parietal plane is horizontal, from the basioccipital condyle upward and backward—a direction not hitherto observed in the reptiles of other orders and families than the present, but resembling that presented by the occiput in relation to the vertex in certain feline mammals. The superorbital plate of the frontal forms an angle obtusely terminated, which projects above the orbit, giving a reniform contour to that cavity (Plate XLV. fig. 2, 11′). A ridge (*f,f*) extends inward and forward from each superorbital protuberance, dividing the fronto-parietal from the fronto-nasal plane. In the middle of the fronto-parietal surface is a pair of tubercles placed transversely. The superoccipital ridge (7 7) is much produced, and is deeply notched at the middle. The occipital plane, owing to the outward expansion of the masto-tympanic plates (Plate XLVI. fig. 1, 8, 28), becomes the broadest part of the skull, the sides of which converge forward to the ridged beginnings of the alveoli of the canine tusks (Plate XLV. figs. 1 & 2, 21). In one orbit a few sclerotic plates were preserved‡. The common absence in dicynodont skulls of these delicate ossifications in the outer coat of the eyeball is doubtless due to easily occurring accident. The occipital condyle (Plate XLVI. fig. 1, 1′) is trilobate, formed by the basi- (1′) and exoccipitals (2′) in nearly equal proportions. The exoccipitals

* Gr. πτυξ, a fold or ridge; γνάθος, a jaw. 'Quarterly Journal of the Geological Society,' 8vo, vol. xvi. (1860), p. 49. † Ibidem. ‡ *Tom. cit.* p. 50, pl. 1. fig. 3, *s.*.

meet above the foramen magnum. The broad plate of bone which they together form is emarginate above for the reception of the mid part of the superoccipital (ib. ib. 3), the suture with which bone thence extends outward and downward in a strongly undulate course to the paroccipitals (ib. 4), with which, as in Crocodilia, the exoccipitals (2) are confluent. The extension of the superoccipital to the parietal is likewise a crocodilian character, and contrasts with the lacertian open structure of the occiput.

There is no trace of sagittal suture; the single parietal is pierced by a small mesial foramen (Plate XLV. fig. 2, 7′) close to the coronal suture; its lateral extensions (*t′*) augment the surface of origin of the crotaphyte muscles. The premaxillaries (ib. ib. 22, 22) constitute a large proportion of the upper surface of the facial part of the skull, their suture (in great part obliterated) forming a ridge along its mid line; half an inch external to this they bend down abruptly anterior to the nostrils, at a slightly open angle with the upper surface, to join the maxillaries (ib. fig. 1, 21) about 8 lines below that bend. The angle of deflection adds a pair of ridges (*p*) to the facial part of the skull. The maxillaries form the lower boundary of the nostrils (ib. fig. 1, *n*), and, behind the narial plate, unite with the prefrontal (ib. ib. 14) and lacrymal (ib. ib. 73) bones. The outer surface of the maxillary is divided by a ridge (ib. ib. *r*) commencing below the orbit, where it seems to be a forward continuation of the zygoma, becoming more prominent as it extends forward, and finally forming the outer angle of the three-sided socket of the canine tusk (see the section, fig. 3, in Plate XLV.). The sockets diverge, as they extend forward and downward, with a slight curve, which is also convex outward (ib. fig. 2, 21). The palatal vacuity between the united portions of the palatines and pterygoids is exposed, anterior to which the bony palate has been broken away. The unambiguous character of the sutures in this "type" of the present genus gives satisfactory evidence of the cranial anatomy of the extinct dicynodontal reptiles.

From a triassic formation in the "sandstone rocks at the foot of the Rhenosterberg," Cape of Good Hope.

Governor Sir George Grey, K.C.B. [P.].

Species *Ptychognathus latirostris*, Ow.

No. S. A. 83. The skull, with the lower jaw: Plate XLVI. fig. 2, Plate XLVII., Plate XLVIII. fig. 2.

The present evidence of the species has the facial part of the skull (Plate XLVII. fig. 1) broader and shorter than in *P. declivis* (Plate XLV. fig. 2); and the orbits are more circular, but with a similar angle of the upper part of the rim by the prominence of the frontals at the outer part of the fronto-nasal ridges (Plate XLVII. fig. 1, 11′, 15′, and Plate XLVIII. fig. 2, *o*). The occiput (Plate XLVI. fig. 2), rather broader in proportion to the height, is less deeply notched at the apex than in *P. declivis*. The occipital condyle is broken away in the present specimen of *P. latirostris*.

The facial plate of the maxillary (Plate XLVIII. fig. 2, 21) is proportionally deeper at the posterior border than in *P. declivis*; its postero-inferior part is produced into a slender-pointed process underlapping the malar (ib. 26) beneath the orbit (*o*).

The alveolar ridge of the canine (ib. *r*) rises more abruptly, and is thicker and more tuberous than in *P. declivis*. The maxillary contributes a small portion to the arched, forwardly directed, alveolar border, anterior to the canine tusks—a peculiarity of contour indicated in No. S. A. 82, and here demonstrated. It demands, and is here shown to have, a corresponding production of the fore part of the mandible (Plate XLVIII. fig. 2, *s*) in order to close the mouth, which thus seems to open upward, as in some uranoscopous fishes.

A median suture between the premaxillaries, if such existed, has been obliterated, as in *P. declivis*; and the bone in both species is single, as in birds and most lizards. It is of unusual length for a reptile, its upper or facial part extending, as in birds, far back to be wedged between the short and broad nasals.

The mandibular rami (Plate XLVII. fig. 3) converge at an acute angle, and unite anteriorly at a broad symphysis. In the side view (Plate XLVIII. fig. 2), commencing behind by a feebly produced angle just below the articulation (29) with the tympanic, each ramus gains in depth as it advances to the symphysis, where they become confluent. The angular element (ib. 30) joins the dentary (32) at two points, and forms the hind boundary of the vacuity (*v*) at the middle of the side of the ramus; the fore part of the vacuity is formed by a bifurcation of the dentary element (32). The upper division, as it advances, develops a thick rounded ridge, which subsides at the oblique channel upon the side of the symphysis which receives the deflected tusks when the mouth is shut (Plate XLVII. fig. 2, *c*, *c*).

From a triassic formation in the "sandstone rocks at the foot of the Rhenosterberg," Cape of Good Hope.

Governor Sir George Grey, K.C.B. [P.].

Species *Ptychognathus boopis*, Ow.

No. S. A. 84. The skull, with the lower jaw, some vertebræ, ribs, and portions of other bones, in the same block of matrix. The skull is figured, of the natural size, in Plate XLVIII. fig. 1 and Plate XLIX. fig. 3.

This species is characterized by the subcircular shape and large relative size of the orbits (Plate XLVIII. fig. 1, *o*), which suggested the specific name. The nostril (*n*) is also large, and opens nearer to the orbit than in the previous species. The temporal fossæ and interorbital tract of the frontals are narrower transversely in proportion to the length of the skull.

The "foramen parietale" (Plate XLIX. fig. 3, 7′) is large. The posterior branches of the parietal (ib. fig. 3, 7) are narrow, not expanded into the arched form. The temporal fossa (ib. *t*) has a more triangular shape than in the preceding species. The extent of the descending plate of the squamosal (Plate XLVIII. fig. 1, 27) which articulates with the tympanic (ib. ib. 28) is instructively shown in this specimen. Part of the pterygoid abutment (ib. ib. 24) is exposed. The upward aspect of the mouth, with concomitant rise of the symphysial end of the mandible, is here repeated (ib. ib. *s*). The right ramus retains its natural articulation with the tympanic pedicle; though mutilated, the vacuity between the angular and dentary elements is traceable.

Both articular surfaces of the vertebral bodies are concave, but one is deeper than the other. The neurapophyses are broad and high; they expand into a moderate platform supported by a lateral ridge or buttress. The neural spine is compressed, broad from before backward, and truncate.

From a triassic formation in the "sandstone rocks at the foot of the Rhenosterberg," Cape of Good Hope.

Governor Sir George Grey, K.C.B. [P.].

Species *Ptychognathus verticalis*, Ow.

No. S. A. 85. The skull, wanting the lower jaw: Plate XLIX. figs. 1 & 2.

The skull upon which this species is founded is but half the size of that of *P. declivis*, from which it differs in the more vertical position of the occiput, of the canines and their sockets, and of the premaxillary part of the skull. The orbits, relatively larger than in the foregoing species, are oval in form, as in *P. declivis*; but the long axis is in the opposite direction, viz. from above downward and backward. The occipital surface (Plate XLIX. fig. 2) is less broad, but higher and more angular above, than in *P. declivis* or *P. latirostris*. The composition of the cranium and lower jaw accords with that of the pre-

fore part of the symphysis is convex both vertically and transversely. The longitudinal ridge on the [illegible] that formed by the canine alveolus of the maxillary; and the alveolar

ceding species. In the relative breadth of the almost flat interorbital platform of the frontal bones, the abrupt downbending of the face, the small size of the nostrils, the ridged canine sockets, and the general angularity of the profile of the skull the present species repeats the generic characters of the foregoing kinds of *Ptychognathus*; and they are well marked in comparison with those species of *Dicynodon* proper (*D. rectidens* and *D. testudiceps*, e. g.) which most resemble *Ptychognathus verticalis* in the relative position and direction of the tusks. A vertical transverse section taken across the base of these tusks shows their wide pulp-cavity at that part, the thin inner wall of their alveoli encroaching upon the nasal cavity; the thin septum narium bifurcates below; the absence of all trace of successional teeth where in such sections their germ is commonly seen in other Saurians is notable, and the great thickness of the undivided facial part of the premaxillary forming the roof of the nasal passages. The bony palate (Plate XLIX. fig. 1) shows the pterygo-palatal vacuity, from which the matrix has been cleared to expose the extension therein of the vomer (13).

From a triassic formation in the "sandstone rocks at the foot of the Rhenosterberg," Cape of Good Hope.

Governor Sir George Grey, K.C.B. [P.].

Species *Ptychognathus Alfredi**, Ow.

No. S. A. 86. The skull, with the mandible naturally articulated thereto: Plate L.

The occiput (fig. 3) shows the same crocodilian extent of ossification as in other members of this singular family.

The condyle (ib. ib. 1′) is formed, as in *Ptychognathus declivis*, by the basioccipital at the lower and middle part, and, in less proportions, by the exoccipitals (ib. 2), which just meet at the upper part of the tubercle. The foramen magnum is a rather narrow oval, with the small end upward, exclusively bounded, externally, by the exoccipitals, the basioccipital appearing at the interspace of the exoccipitals immediately within the cranial cavity. The basioccipital (ib. ib. 1), in advance of the tubercle, has its lower surface at first concave, and then convex, lengthwise, and is more deeply concave transversely through the production of its sides into the short and thick hypapophyses (1*). Its junction with the basisphenoid is by an almost straight transverse harmonia. The hypapophyses are divided by a short notch from the paroccipitals (ib. ib. 4), which abut, as in Crocodilia and Chelonia, against the inner side of the tympanics (28), but here against their lower half, fixing these bones more firmly in their position. The paroccipitals, as in the Crocodile, are exogenous growths of the exoccipitals (ib. 2). The superoccipital (ib. 3) forms the upper part of the occipital surface, is of a vertically oblong or subtriangular form, with the apex downward, and terminating some distance above the foramen magnum. The sides of the superoccipital concavity are formed by the backwardly projecting and slightly diverging hinder end of the parietals (ib. 7), between which and the exoccipitals the broad and angular mastoids (ib. 8) are wedged, forming the upper, outer, and posterior outstanding backwardly bent ridge for the attachment of the cervical muscles, and presenting the sutural surface to the squamosal (27) and the upper end of the tympanic (28). The upper surface of the parietal presents a roughish non-articular tract about 8 lines in breadth, at the fore part of which is the venous foramen (fig. 2, 7′). This median tract is made slightly concave across by the elevation of the ridges (7, 7) bounding the smooth, longitudinally concave tracts affording origin to the temporal muscles.

The frontals (ib. 11, 11) form the chief part of the flattened vertex or upper platform of the cranium. They extend longitudinally from the foramen parietale forward to about one third of an inch from the prefronto-nasal ridge (fig. 2, 11′–*f*), and transversely to the superoccipital ridges, of which they form about the middle third part. The median or frontal suture may be traced along a great part of its extent: the surface is slightly raised at this part, and is depressed laterally, between the median rising and the slightly elevated orbital borders. There is no trace of the pair of tubercles which in *Ptychognathus*

* Phil. Trans. 1862, p. 456.

The mandibular rami (Plate XLVII. fig. 3) converge at an acute angle, and unite anteriorly at a broad

declivis stand transversely on the frontal platform, in the line bisecting the middle of the orbits: they have not been chipped away in clearing off the matrix; the median rising at the frontal suture is continued backward over the part where it divides to go to each tubercle in *Ptychognathus declivis*. The frontal tubercles may be therefore reckoned among the cranial characters distinguishing *Ptychognathus declivis* from the skull of the species under description. In this, as in the previously defined species of *Ptychognathus*, the vertex or upper surface of the skull is bounded anteriorly by a low ridge (fig. 2, 11′, 11′, *f*, *f*), extending transversely with a slight curve, convex forward, from the fore part of one superorbital border to the other. The ridge is formed by the nasals (fig. 2, 15) at the middle, and by the prefrontals (ib. 14) at the sides. The latter are strong, large, angular bones, dividing by a prominent tuberosity (11′) the fore from the upper borders of the orbit: the frontal surface of the prefrontal is divided by the before-described ridge from the facial surface; both are slightly concave, the latter of greater extent, reaching almost to the hinder angle of the external nostril (fig. 1, *n*), and articulating with the nasal (ib. 15) above, and with the lacrymal (ib. 73) below. The nasals (15), divided by a median suture, bend abruptly, at the prefronto-nasal ridge, from the upper to the fore or facial part of the skull, at an open angle. They diverge to form the upper border of the nostrils, and join the upper and hinder ends of the coalesced premaxillaries (ib. 22). The premaxillaries continue the facial line, begun by the nasals, straight to the upper margin of the mouth, which margin is directed forward. There is a slightly elevated line along the place of the obliterated median suture (fig. 2, *m*), parallel with which is a pair of similar linear ridges (fig. 2, *p*, *p*), dividing the median from the lateral surfaces of the premaxillary: these surfaces have almost the same breadth, except that the lateral surface (fig. 1, 22) increases near the oral border; it is narrowest where it forms the fore part of the nostril (*n*).

The maxillary (figs. 1 & 3, 21) is chiefly remarkable, as in the rest of the genus, for the strong ridge-like prominence (*r r*) of the socket of the long and large canine tusk (*c*). Between this and the outer premaxillary ridge the sides of the face are slightly sinuous, the convexity above gradually changing to a deeper concavity below, in the transverse or vertical direction; lengthwise the sides of the face are slightly concave as they converge towards the mouth, except at the canine alveoli, which are a little convex lengthwise at their fore part. Above, the maxillary bounds the lower part of the nostril, and there unites with the premaxillary (22) and lacrymal (73); below, it is continued from the canine-socket inward and downward, forming the edentulous sectorial border which meets the corresponding part of that border of the mandible (32), the fore part of which, in advance of the maxillary, is strongly bent upward (*s*) to meet the edentulous border of the premaxillaries (*n*).

The lacrymal (73), forming the middle of the fore part of the orbit, extends upon the face apparently to the nostril. The malar (26), curving back along the lower part of the orbit, the border of which it there forms, bifurcates behind to connect itself with the postfrontal (fig. 1, 12) above and with the squamosal (fig. 1, 27) behind. There is no other bony bridge overspanning the temporal fossa, except the normal malo-squamosal zygomatic arch. The squamosal combines with the mastoid in affording the articular sutural surface to the upper end of the tympanic (28).

The mandible of *Ptychognathus* (fig. 1, 30–32) resembles that of the Chelonia in its edentulous condition, general proportions, and comparative simplicity of structure, and that of the Crocodilia in the vacuity left between the dentary (32), angular (30), and surangular (31) elements; but it is peculiar and ptychognathic in the sudden vertical expanse and upward curve of its symphysial end (*s*), the vertical diameter being here three times that of the articular end. I cannot distinguish an articular from a surangular element: the suture between this and the angular extends near and runs parallel with the upper border of the surangular to the vacuity, towards which it bends. No coronoid process is developed, nor is there any coronoid or complementary ossicle as in modern Lizards, Chelonians, and Crocodiles. The splenial element (fig. 4, 29) extends far back, as in Chelonia. The dentary elements, confluent at the symphysis, are deeply notched at their narrow hinder part, the upper projection being the longest. A horizontal ridge extends from the upper part of the notch forward as far as the depression lodging the end of the canine tusk when the mouth is shut. The vacuity is situated halfway between the two ends of the mandibular ramus, not in the posterior third as in the Crocodile. The symphysis is broad as well as high; and the rami meet there so as to form, below, an arch or curve, concave backward (fig. 4, *s*). The

fore part of the symphysis is convex both vertically and transversely. The longitudinal ridge on the outside of the dentary parallels that formed by the canine alveolus of the maxillary; and the alveolar borders in both incline inwards, to meet at the oral margin behind the great tusks. Of the right of these a longitudinal section has been made (Plate L. fig. 6) exposing the extent of the pulp-cavity (ib. *p*, *p*), which closely conforms to that in the ever-growing tusks of the Boar and Walrus amongst the Mammalia. As in the specimens of *Dicynodon* (*e. g.* No. S. A. 54) such section of the socket and long implanted base of the canine exhibits no trace of a germ of a successional tooth.

From "A greenish sandstone of the Rhenosterberg," Cape of Good Hope.
His Royal Highness the Duke of Edinburgh, K.G. [P.].

Species *Ptychognathus depressus*, Ow.

No. S. A. 87. The skull, with the mandible naturally articulated: Plate LI.

The angle at which the occipital (fig. 1, *o*) meets the parietal (ib. *p*) surface is more acute than in *Ptychognathus declivis* (Plate XLV. fig. 1); that at which the parieto-frontal (Plate LI. fig. 1, *pf*) meets the fronto-nasal (ib. *fn*) surface is more open than in any other known kinds of Anomodontia. The whole cranium is flatter, of less vertical extent, whence the name of the species. The mandible is less deep in proportion to its length.

The orbit (ib. fig. 1, *o*) is large and oblong, the antero-posterior much exceeding the vertical diameter. The superorbital protuberance is less anterior in position; in these protuberances, and the ridge converging from them (fig. 2, *f*, *f*), the ptychognathic characters are exemplified. The temporal fossæ (*t*) are narrower antero-posteriorly in proportion to their breadth than in *P. declivis*. The mouth is more contracted laterally; and the mandibular rami meet with a minor degree of transverse curve than in the preceding species. The canines and symphysis mandibulæ are relatively small (ib. fig. 3).

From a triassic formation at "Stylkrantz, Sneewberg mountain-range," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Dicynodontes *incertæ speciei.*

No. S. A. 88. The distal half of the right humerus of a dicynodont reptile of smaller size than *D. pardiceps*.

It is perforated obliquely above the inner condyle, as in *Cynodracon* (S. A. 40) and as in S. A. 72, by the extension of a bony bridge from the termination of the delto-pectoral crest to the fore part of the entepicondyle. The entocondyle itself is continued upon the thenal surface as a well-marked convexity, a character which has been effaced by fracture in S. A. 72. The fracture near the contracted middle of the shaft exposes the compact osseous texture and absence of any medullary cavity. The anconal depression is wide and shallow, but is better defined than in the larger specimen.

From a locality, not noted, in South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 89. A slab of reddish sandstone with impressions of the neural arches and ribs, of cervical and dorsal vertebræ, and of bones of the left fore limb of a young or small dicynodont reptile: Plate LII.

Eight ribs of the left side are shown—long, slender, moderately curved, with a feeble longitudinal impression (fig. 1). The distal end of the humerus is much expanded; the radius and ulna are distinct and in a prone relation (fig. 2); the palm of the fore paw has impressed the surface of the slab transmitted. This impression is pentadactyle; the digits are short; and the breadth of the paw equals the length, including the carpus (fig. 3).

The innermost digit, or pollex (I), has two phalanges; the rest have each three phalanges. The slight increase of length of the medius (III) is due to that of its constituent phalanges. The metacarpals of the fourth (IV) and fifth (V) digits are relatively longest; that of the pollex is the shortest. The ungual phalanx of the pollex is longer than that of the minimus; but there is less difference in length and composition of the several digits than in most existing reptiles.

The ungual phalanges are feebly curved and pointed, indicative of having been armed with prehensile claws. The agreement with the mammalian formula of joints in this five-toed hand extends the relationship to that class which the structure of the humerus has indicated.

From triassic deposits of the Sneewberg range.

Thomas G. Bain, Esq., by Governor Sir Henry Barkly, K.C.B. [P.].

No. S. A. 90. A cast in plaster taken from the preceding impression, showing the parts that made it in relief.

The original specimen, with a large proportion of the skeleton, was discovered in triassic deposits of the Sneewberg range by Thomas G. Bain, Esq., son of the late Andrew Geddes Bain, F.G.S., and his successor in the office of "Inspector-General of Roads" at the Cape of Good Hope.

Hearing of this discovery I wrote to the Governor, Sir Henry Barkly, K.C.B., who, in his reply (15th September, 1874), kindly promised to interest himself in the acquisition of this and other fossils, and added:—"Meanwhile I think it better to send you by the mail-steamer 'Africa,' which leaves for Southampton to-morrow, the fragment first given to me by Mr. Bain, as it presents a good specimen of the creature's paw." The specimen was duly received at the British Museum, and the above cast taken of the impressions. Unfortunately there is no evidence of the cranial or dental characters. Reference of the fossil to the dicynodontal group of South-African Reptilia must be conjectural until the rest of the skeleton, and especially the skull, be obtained and transmitted.

No. S. A. 91. A portion of matrix, with a fragment of a humerus and bones of a pentadactyle paw, probably of a Dicynodont.

Assuming the proximal series of the latter bones to be metacarpals, no digit shows more than three phalanges, the proximal and middle of which are short, broad, and seemingly subdepressed; the ungual phalanx is relatively longer in proportion to its basal breadth, and, in the best-preserved digit, is slightly curved and pointed. The three middle digits are subequal in length.

From a triassic deposit in the "Graaf-Reinet district."

R. N. Rubidge, Esq., M.B. [P.].

No. S. A. 92. A cast of six hinder trunk-vertebræ, with part of the sacrum and pelvis, of a small or young dicynodontal (?) reptile. The original specimen is figured in Plate LIII. fig. 1.

In the view of the sacrum and iliac part of the pelvis given in the paper "On Dicynodont Reptilia"*,

* Philosophical Transactions, 4to, 1862, p. 462.

median vacuity, formed by the [illegible]pes (20) and pterygoids (24, fig. 1, Plate LVI.). Anterior to this

plate xxiv. fig. 3, the abutment of long transverse processes against the ilia is shown to keep those bones wide apart from the bodies and spines of the sacral vertebræ.

In Crocodiles and Lizards (*Varanus*) the sacral ribs are long as well as thick, but do not exceed two pairs in any existing reptiles of these orders; in most Chelonia there are three sacral vertebræ *. In the pelvis assigned to *Dicynodon tigriceps* (*loc. cit.*) six pairs of such long and stout pleurapophyses abutted against correspondingly extensive iliac bones; but those of the first pair were unusually expanded at their iliac ends, underlapped the ilia, and were syndesmotically attached to a broad tract of the under or ventral surface of the ilia (as in Plate XXXVI. fig. 1 of the present Catalogue). The rib of the anterior sacral vertebra in most Lizards expands at its iliac end, and in the Monitors (*Varanus niloticus*, e. g.) bends downward and backward so as to apply its lower border to the ventral surface of the ilium.

The analogous development of the anterior sacral pleurapophysis is carried so much further in Dicynodonts that it simulates the ilium itself in its expanded type. Of this remarkably developed element of the dicynodontal pelvis, portions of both right and left are exposed, from the dorsal aspect, in the subject of Plate LIII. fig. 1.

On the right side the head of the rib articulated to the first sacral vertebra is preserved; the head and neck show a thickness of 3 lines; the bone then rapidly expands into a plate 1 inch 3 lines in breadth (*pl*), which is overlapped (seen from the dorsal aspect) by a similarly expanded ilium (ib. 62).

On the left side the narrower connecting part of the pleurapophysis with its vertebra has been destroyed, but the terminal expansion, in similar relation to the ilium, remains. So much of the latter bone as is preserved agrees with the corresponding bone in *Dicynodon tigriceps*. Five sacral vertebræ, the foremost inclusive, are fragmentarily represented in the present specimen.

A portion of the head and shaft of the left femur remains in articular relation to the pelvis, and parts of the ischium and pubis are traceable on the ventral surface of the fossil fragment. The four vertebræ preceding the first sacral retain more or less of their pleurapophyses. Those of the hindmost are directed outward and forward for the extent preserved, which is about an inch. Of the ribs of the three antecedent vertebræ rather more remains. Each rib has a thickness of 4 lines at its junction with the vertebra, which is to a diapophysis developed from the neural arch. Thus (as in the specimen No. S. A. 67, Plate XXXVI.) the rib-characters of dorsal vertebræ are continued to the vertebra articulating with the sacral series.

The original, from a locality, not noted, in the Cape of Good Hope, was transmitted for determination and description, with permission to take a cast, by

The Directors of the Museum of Cape Town.

No. S. A. 93. Portion of the right scapular arch of a small Dicynodont, including the articular end of the scapula, the coracoid, and part of the precoracoid or clavicle: Plate LXIX. figs. 5 & 6.

Of the scapula the expanded articular end only is preserved; its extreme breadth, including the acromial process (*e*), is more than twice that of the body of the bone where broken off. The fracture here gives an elongate semioval figure or transverse section, the straight border being outward or toward the articular cavity (fig. 5, *d*, *f*); its fore end (ib. *b*) extends upon the termination of a ridge or process. Beyond this the bone expands and bifurcates; the larger and thicker division, or body of the bone (*c*, *d*), forms the two articular surfaces, the larger of which (*d*) is "humeral;" the smaller surface joins the coracoid. This bone (52), which contributes the lower angle (*f*) of the "glenoid cavity," thins off from the articulation, and expands into an inequilateral triangular plate; the hind border is thicker than the others; the median or lower border (52) is the longest and is convex; the anterior border is straight, and is suturally united to the third anterior flattened broad bone. So much as is preserved of this bone (precoracoid or clavicle?) is subtriangular; its upper or "scapular" border is notched (*o*). The thicker

* Anatomy of Vertebrates, 8vo, vol. i. p. 65.

Eight ribs of the left side are shown—long, slender, moderately curved, with a feeble longitudinal

hinder division unites with the scapula close to the glenoid cavity, without contributing thereto; the anterior thinner portion unites with the acromial process (*e*) of the scapula, and is marked off by a wide and deep posterior groove from the thick coraco-humeral articular end of the bone. The junction of the acromial process of the scapula with the bone (*n*) converts the opposite notches into a foramen (*o*). The fissure extending from *o* to *n* is an accidental fracture; the line between the coracoid and precoracoid is a veritable and natural suture. Part of the precoracoid has been broken away.

From a triassic formation of the Rhenosterberg, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Fam. CRYPTODONTIA*, Ow.

Genus Oudenodon†, Bain.

Char. Upper as well as lower jaw edentulous; premaxillaries confluent; maxillaries with a caniniform production of the alveolar border.

Species *Oudenodon magnus*, Ow.

No. S. A. 94. The skull, wanting the lower jaw: Plate LIV., nat. size; Plates LV. & LVI., half nat. size.

This specimen, as worked out of a large block of hard and intractable triassic (?) clay-stone, presents a subdepressed elongate form. Horizontally the cranial or postorbital part (Plate LV., 7, 8, 12) is subquadrate; but the superoccipital termination is wanting. From the temporal fossæ (*t*, *t*) the skull contracts to the premaxillary apex (22). Vertically (Plate LIV.) the facial part of the skull (73, 22) gains depth from the orbit to the caniniform process (*c*) of the maxillary (21), then rapidly contracts to the subdecurved apex of the upper jaw (22). The temporal fossæ (Plate LV., *t*, *t*) meet and develop a crista upon the parietal region (ib. *t'*), in front of which a foramen parietale (ib. 7') is traceable. The lower or zygomatic boundary of the fossa is massive, and adds to the indications of the power with which the edentulous mandible was worked upon the upper jaw. The orbit (Plate LIV., *o*) is longitudinally oval in form, the great end turned forward. The nostril (*n*), also longitudinally oblong, opens midway between the orbit and the apex of the upper jaw. In quest of any indication of the germ or débris of a canine, a horizontal section was taken across the base of the caniniform process (*c*); but the ordinary close cancellous texture of the maxillary bone (as shown at *c'*, Plate LIV.) prevailed; no trace of tooth or socket was discernible. Anterior to this process the alveolar border of the upper jaw is subtrenchant.

The interorbital tract of the frontals (Plate LV., 11) is on a lower level than the parietal crest, and is broad and flat, save where it sinks to the superorbital border. A low protuberance of the nasal (Plate LIV., 15) overhangs part of the nostril. The palatal nostril appears to have opened into a single

* Gr. *κρυπτὸς*, hidden; *ὀδοὺς*, tooth.

† Gr. *οὐδεὶς*, none; *ὀδοὺς*, tooth. Mr. Andrew Geddes Bain, F.G.S., the discoverer of the bidental reptiles of South Africa, in a letter published in the 'Eastern Province Monthly Magazine,' September 1856, thus notices (p. 10) another form of fossil reptile occurring in the triassic rocks near Fort Beaufort:—"There were many skulls entirely without teeth, which we at first thought had belonged to Chelonians or Turtles; but afterwards finding that the animals had distinct narrow ribs, which Chelonians have not, we put them down also as something new, and named them 'Oudenodones,' or toothless animals."

median vacuity, formed by the palatines (20) and pterygoids (24, fig. 1, Plate LVI.). Anterior to this vacuity the bony palate shows a median ridge (13), in advance of which the palate is mutilated. The single occipital condyle (1), the strong pterygoid abutment (24′) against the fixed tympanic (28), and the wide inferior aperture of the temporal fossa (*t*) are shown in the reduced view of the base of this remarkable skull, in the above Plate.

From the triassic rocks "at East Brak river, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 95. The dentary element of the lower jaw of *Oudenodon magnus*. A side view of this fossil is given, of the natural size, in Plate LVII.

The apex of the symphysis is produced upward; its alveolar surface presents a pair of shallow subcircular depressions (fig. 2, *a*, *a*); of these a test-section was made, but exposed only the cancellous texture of the bone (as at fig. 3). Supposing the alveolar part of this edentulous jaw to have been sheathed, as in Chelonian reptiles, with hard, horny matter, the apical portion might have had its attachment to the bone strengthened by penetrating these pits, or might have derived material from the vascular matrix therein imbedded for renewal of the substance of the beak-sheath, or processes, which might be more rapidly worn away at that part of the jaw.

From the triassic rocks "at East Brak river, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 96. The distal end of the left humerus of *Oudenodon magnus*.

It is remarkable for the great size and convexity of the radial condyle, as compared with that of the ulnar trochlea, also for the considerable expansion of the distal extremity as compared with the diameter of the shaft, which latter does not exceed 2 inches 6 lines. The "supinator ridge" has been broken away from a base of 6 inches extent. The ectepicondyle is likewise broken off. There is no medullary cavity in the shaft at the part fractured*.

From a triassic formation "at East Brak river, near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Oudenodon brevirostris*, Ow.

No. S. A. 97. A mass of matrix, in which have been exposed parts of the skull, wanting the lower jaw. This specimen is figured, of half the natural size, in Plate LVIII.

In this mass of the densest and most intractable petrified blackish quartzose mud have been wrought out indications of the extent and shape of the depressed occipital surface, of the temporal fossæ (fig. 1, *t*), of the orbits (ib. *o*), of the nostrils (ib. *n*), and of part of the bony palate (fig. 2).

The occiput appears to have inclined from the basioccipital upward and forward, as in Reptilia generally. The temporal fossæ are of unusual size, occupying more than the hinder half of the skull, and pushing the orbits beyond the midway into the fore half of the skull, the nostrils and rostrum occupying a short tract in advance of the orbits. These cavities are also remarkable for their transverse extent and

* See 'Transactions of the Geological Society,' 2nd series, vol. vii. p. 246, pl. xxxiv. fig. 4, "Distal end of humerus or femur." The subsequent reception and exposition of the fossil humeri, Nos. S. A. 72 & 82, afford evidence weighing in favour of the humeral character of this fossil.

upward aspect; they are oval in contour, and seem to have had the small end turned outwards; moreover a convex prominence of the floor of the orbit (fig. 1, *o'*, *o'*) projects into the anterior half of the cavity. The surfaces of origin (ib. *t'*, *t'*) of the temporal muscles appear to have met, or to have been divided by, a ridge on the parietal region.

There is a narrow ridge in the place of the socket of the canine in Dicynodonts, but, as in other Oudenodonts, without trace of tooth. The postero-lateral boundaries of the palato-naris (*n*) came clearly out (as shown in Plate LVIII. fig. 2), together with the union of the pterygoids (24) with each other and the basisphenoid and a partial exposure of the diverging branches of the pterygoids (24'), to abut against the tympanics.

From a triassic formation in the district of Graaff-Reinet, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 98. The fore part of the mandible of *Oudenodon brevirostris*. It is figured, of the natural size, in Plate LIX.

It shows the absence of the symphysial constriction for the canines present in Dicynodonts, and the more posterior position of the ridge of the dentary element (fig. 1, 32) characteristic of the present genus. The symphysial end of the coalesced dentaries is produced upward, and has a subtrenchant margin (fig. 3, *s*, *s*): the thicker posterior alveolar border of the dentary is grooved (ib. *a*, *a*). The angular elements converge and unite (fig. 2, 30) to prolong backward the symphysial part of the lower jaw.

From a triassic formation in the district of Graaff-Reinet, Cape of Good Hope.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Oudenodon Bainii*, Ow.

No. S. A. 99. The skull, wanting the lower jaw: Plate LX. and Plate LVI. fig. 2.

In this species the back part of the skull, greatly extended in breadth by the expanse of the lamelliform sinuous masto-tympanics, inclines from above the occipital condyle upward and forward, the superoccipital (Plate LX. fig. 2, 3) being continued into the parietal (ib. 7) by a longitudinal channel between the parieto-mastoid cristæ, where the back part passes into the upper part of the cranium.

The temporal fossæ (ib. ib. *t*) are longer than they are broad, and are relatively much longer and narrower than in the *Ptychognathus*; in this respect *Oudenodon* more resembles *Dicynodon*; a relatively wider space is left between the temporal ridges at the upper or parietal region of the cranium. The zygoma (26, 27) is a long, rather slender, compressed bar, with its upper border directed obliquely upward and outward, its inner side obliquely upward and inward. The postfrontal bar (12, 26), dividing the temporal fossa from the orbit, is directed from within outward, backward and slightly downward. The interorbital space (fig. 2, 11) is narrower than the intertemporal one, so that the lower border of the orbit has a more outward position than the upper one, and the aspect of the orbit is very oblique, rather more upward than outward. The profile of the face descends by a regular curve from the upper to the fore part, which is nearly vertical,—the premaxillary (fig. 1, $\bar{22}$) being continued more nearly to the level of the alveolar border of the maxillary (21) than in *Ptychognathus*. There is a low tubercle upon the prefrontal part of the orbital border; and a somewhat larger tubercle projects above the nostril. This cavity is relatively larger than in *Ptychognathus declivis*; and both premaxillary and maxillary are more deeply notched to form its fore and under boundary: the nasal, prefrontal, and lacrymal complete that boundary. Below the middle of the orbit a thick, smoothly rounded, vertical ridge projects from the maxillary (ib. 21), in the position of the alveolus of the tusk in *Pt. verticalis*; but it rather suddenly subsides upon the alveolar border, which is here entire and imperforate, forming simply a low obtuse

angular projection upon that border. A longitudinal section demonstrates this ridged part of the maxillary to be solid to near the orbit, where a conical cavity is exposed filled by matrix. No trace of a calcified germ was present; if the matrix of a canine had there been developed, it has been absorbed before calcification had commenced. The rest of the alveolar border, chiefly formed by the premaxillary, is toothless and subtrenchant, as in Dicynodonts. No trace of longitudinal ridges was discovered in clearing out the fore part of the palate (Plate LVI. fig. 2, 22).

The composition of the skull is essentially the same in *Oudenodon* as in *Dicynodon*; and the same affinities may be predicated of it, with such additional approach to Chelonia as the total absence of teeth may indicate. But the double nostril (ib. fig. 3, *n*, *n*) and well-ossified occiput demonstrate the more essential Saurian affinities of the genus.

From a triassic formation "near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Oudenodon prognathus*, Ow.

No. S. A. 100. The orbital and facial part of the skull, with the corresponding portion of the mandible: Plate LXI.

The present species resembles *Ptychognathus* in the length of the face, and more especially *Pt. latirostris* in its direction and in the relative position of the ridge representing the canine's socket (Plate LXI. fig. 1, 21) to the nostril (*n*). In *Oudenodon Bainii* this ridge is behind the nostril; in the present species it is beneath it, and is more horizontal than vertical.

The orbits (*o*) have the same oblique aspect, upward and outward, as in *O. Bainii*, but their longitudinal exceeds their vertical diameter; the nostrils have a similar longitudinally oval shape, and are more directly in advance of the orbit; the supernarial tuberosity (ib. 15) is relatively larger. The maxillary ridge (21) is more angular and more produced, besides being continued more obliquely forward. The produced and sloping part of the premaxillary has a nearly straight contour (22), and is strengthened, as in *Ptychognathus*, by a low median obtuse ridge (fig. 4, 22). The maxillary ridge subsides below to the edentulous alveolar border rather more gradually than in *Oudenodon Bainii*, its outer longitudinal contour forming a gentle convex curve; these ridges (fig. 3, 21, 21) give a peculiar feature to the present skull. The fore part of the premaxillary does not descend so nearly to the level of the maxillary alveolar process as in the *Oudenodon Bainii*; and consequently the symphysis of the mandible (fig. 1, *s*) is more produced and curved upward, which is another feature of resemblance to *Ptychognathus* in the present skull,—the depth of the symphysis here exceeding the same diameter of the opposed fore part of the upper jaw. The symphysis is narrower in proportion to its length than in *Ptychognathus*; its fore part is slightly produced along the middle line, resembling a low ridge. The vacuity between the dentary and angular elements is long and narrow; it is overarched by a slight ridge; but this does not extend forward as in *Dicynodon*, nor does the mandible show the constriction for the lodgement of the crowns of the canines as in the toothed genera.

From a triassic formation "near Fort Beaufort," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Oudenodon Greyii*, Ow.

No. S. A. 101. An obliquely crushed specimen of the skull, with the lower jaw: Plate LXII. and Plate LXV. fig. 8.

This species, with maxillary ridges as in *O. prognathus*, has a less elongated cranium and temporal

fossæ, more rounded orbits, and a narrower interorbital space. At the under part are several bones, constituting a symmetrical apparatus in the position of the hyoid, beneath and between the rami of the lower jaw, where they are evidently in advance and rather to one side of their proper position (Plate LXV. fig. 8). The hindmost, on the middle line (ib. 43), is best preserved. It is broad, flat, and very thin, of a symmetrical semicircular form, with a production like a stem from the middle of the straight side, which is directed forward. This stem is partly underlapped by the median end of a pair of long, narrow, flattened bones (ib. 45), which proceed transversely outward, slightly expanding to that end. Their anterior border is straight; the posterior border is slightly concave.

To the outer end of each of these bones seems to have been connected or articulated a long slender bone (ib. 46), with a slight sigmoid curve, directed backward. The following appear to be the homologies of the foregoing bones. The median and most posterior of them is the uro-hyal (43). The transverse pair answer to the hindmost pair (*a a*) in the hyoid of the Tortoise, figured by Cuvier in the 'Ossemens Fossiles,' 4to, tom. v. pt. ii. pl. 12. fig. 42; it is the "basibranchial" (45). The longitudinal pair appended to them answer to *c c* in the same figure; they are the "hypobranchials" (46)*.

In advance of the left basibranchial is a flattened broad lamelliform bone, with the fore and hind borders convex, the outer and inner ones concave; but the median or inner border of this plate is not entire. The bone in question may be either a median symmetrical piece, like the urohyal, but displaced; or it may be the left of a pair of plates, answering in that case to the middle pair (*a a*) in the above-cited figure of the hyoid of the Tortoise. I incline to the latter opinion, and believe it to be the half of a basihyal (41) divided in the median line. To the outer concavity of this bone has been attached the end of a long and strong bone, flattened and gradually expanded at both ends; it is directed outward and backward. It is a large and strong ceratohyal (40), and is double the length of the hypobranchial or posterior "cornu."

The lower jaw in the skull showing the above-described hyoid apparatus is $4\frac{1}{2}$ inches long. The length of the ceratohyal is $3\frac{1}{2}$ inches; that of the hypobranchial is $2\frac{1}{4}$ inches. The length of the urohyal (4) is 1 inch; its breadth is nearly the same.

In Crocodilians there is a broad cartilaginous basihyal suspended by a pair of strong bony ceratohyals; but there are no distinct thyrohyals (hypobranchials), nor any urohyals.

In Lacertians there are both cerato- and thyrohyals; and in some genera of Iguanians and Lizards proper (*Lacertia*, Cuv.) there is a long and slender bifurcated urohyal or pair of urohyals. The thyrohyals are not supported on distinct bones, answering to the basibranchials (45).

In Chelonians the urohyal is wanting; but in some species (*Testudo elephantopus*) the thyrohyals or hypobranchials are articulated to a pair of bones answering to the basibranchials in fishes, which diverge from each other to form those articulations.

In *Oudenodon*, and probably also in *Dicynodon*, the type of the hyoid apparatus conforms most with that in the Chelonia, but combines therewith certian Lacertian characters.

In the composition and general form of the skull *Oudenodon* so closely resembles *Dicynodon* and *Ptychognathus* as to indicate a general family relationship. Viewing, indeed, the ridged indication of the sockets of the pair of upper canines in *Oudenodon*, the surmise is suggested whether the species of this genus may not originally have possessed tusks, which after having been shed had not been replaced, leaving the cavity of the sockets to absorption and obliteration. Or it might be asked whether the Oudenodonts may not be the females of Dicynodonts, in which, as in the Narwhal, rudimental tusks may have been originally hidden in the substance of the ridged tracts of the upper jaw and afterwards absorbed. Hitherto, however, I have not met with species of *Dicynodon* or *Ptychognathus* sufficiently resembling any *Oudenodon* in cranial characters to support their ascription to the same species with merely the sexual difference with respect to tusks.

From the triassic sandstone of the Rhenosterberg, Cape of Good Hope.
Governor Sir George Grey, K.C.B. [P.].

* See my 'Archetype of the Vertebrate Skeleton,' 8vo, pp. 68 & 71.

Species *Oudenodon* (?) *strigiceps*, Ow.

(*Dicynodon strigiceps**, Ow.)

No. S. A. 102. The anterior or rostral part of the skull: Plate XLIV. fig. 4.

In the remarkable form represented by the present fragment the antorbital part of the skull is as much shorter than that of *Oudenodon brevirostris* as this is in comparison with the skull of *Oudenodon magnus*. The breadth of the interorbital space in the present species is nevertheless relatively as great as in *Oudenodon Bainii*; but it is more concave. The internarial breadth is equal to that in *Oudenodon prognathus*; but the rostral contour, continued from the horizontal interorbital tract, describes, in descending, a semicircular curve, convex forward, with the lower part bending back to the edentulous "alveolar border" of the premaxillaries. This form of muzzle is unique in the reptilian class, according to present experience. The orbits (*o*), with their prominent anterior borders (14), are thus brought close to the fore part of the head; the external nostrils (*n*), instead of being in front of the orbits, are beneath them. The physiognomy of the old Saurian must have resembled that of the Owl, with its horny beak curving downward and backward from between the advanced eyes, whence the specific name so suggested. But to this grotesque mask may have been added a pair of tusks descending vertically (as in the Walrus), yet not in front, but beneath or rather behind the orbits; of these tusks, however, the present specimen shows no definite trace.

From a triassic formation in the "Taka prolongation of the Winterberg range of mountains," Cape of Good Hope.

Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Oudenodon raniceps*, Ow.

No. S. A. 103. Cast of a small block of matrix, with portions of the skull.

The occipital condyle is low and broad; the lateral portions contributed by the exoccipitals simulate the Batrachian double condyle. The superoccipital surface is much depressed. The temporal fossæ are large, with the long diameter lengthwise. The orbits appear to have been small.

The original specimen, now in the Museum of Harrisberg, from triassic deposits at East London, British Caffraria, was transmitted for the above determination and description by The Directors of the Museum.

No. S. A. 104. Cast of a portion of the same block of hard dark matrix, with the mandible of the same skull. It shows the longitudinal ridge and vacuity on the right ramus.

The original specimen, now in the Museum of Harrisberg, from triassic deposits at East London, British Caffraria, was transmitted for the above determination and description by The Directors of the Museum.

* Trans. Geol. Soc. 2nd series, vol. vii.

Species *Oudenodon megalops*, Ow.

No. S. A. 105. A mutilated skull, wanting the lower jaw: Plate LXIII. figs. 4 & 5.

As the temporal fossæ seem, by the muscular impression (*t'*, fig. 4), to have met on or near the sagittal suture, this specimen may be inferred to have come from a mature individual. Its chief feature is the large proportional size of the orbits (ib. *o*, *o*). The vomerine ridge (fig. 5. 13) is shown on the fore part of the palate; but this is not preserved to its anterior end; on that part which remains there is no trace of the pair of premaxillary ridges answering to those shown in *Dicynodon* (Plate XXXIX. fig. 2 and Plate XLIV. fig. 2).

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 106. A nodule of matrix, on which are exposed a pair of upper canines; they are small, and the implanted base does not, as in No. S. A. 79, expand to form a large pulp-cavity for the matrix of a growing tooth, but it contracts to a closed end, indicative of the conclusion of growth of such canine (Plate XXVII. fig. 3, *c*). Were such teeth shed and not replaced, the oudenodont character would be assumed. A vertical longitudinal section of this nodule has been made; it is figured in Plate XXVI. fig. 4; the premaxillary is indicated at 22; the mandible at 32.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Genus Theriognathus*, Ow.

Species *Theriognathus microps*, Ow.

No. 107. A mutilated skull, with the lower jaw. It is figured, of half the natural size, in Plate LXIII. figs. 1, 2, & 3.

The whole of the outer surface of the skull has been worn away, showing the fibrous osseous texture; but the relative size of the temporal fossæ (fig. 1, *t*, *t*) and of the orbits (ib. *o*, *o*) are instructively defined. The low vertical development of the symphysis mandibulæ (fig. 3), the acute angle at which the rami there meet (fig. 2, *s*), and the increase in vertical extent of the ramus as it passes backward, rising as a high coronoid process (fig. 3, *c*) into the hinder half of the temporal fossæ, combine to indicate the generic distinction of this seemingly edentulous skull from that of the type genus *Oudenodon*.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

* Gr. *θηρίον*, wild beast; *γνάθος*, jaw.

Genus KISTECEPHALUS*, Ow.

Species *Kistecephalus microrhinus*, Ow.

No. S. A. 108. A nodule of dark triassic matrix, with the skull, wanting the lower jaw. It is the subject of figures 4–7, Plate LXIV.

Much of the outer surface of the bones is also here abraded; but sufficient remains to show the singular proportions of the skull, which is broader than it is long, and of which the occipital depth (fig. 6) nearly equals the length. The maxillaries and premaxillaries appear to be edentulous, with a canine-like production of the alveolar border on each side of the upper jaw (figs. 5 & 7, *c*) as in the typical Oudenodonts; but the small relative size, anterior position, and forward aspect of the nostrils justify a generic distinction, which is supported by the proportions and box-like shape of the skull, which has suggested the generic appellation.

The orbits are large, the temporal fossæ (*t*) rather larger. A condylar portion of the basioccipital is seen at 1, fig. 6; the exoccipitals (2, 2) circumscribe the foramen magnum; this has a vertically oval shape. The paroccipital (4) abuts against a broad tympanic (28); the superoccipital (3) is much expanded, and joins broad mastoids (8) and parietals (7). The latter seem to swell out on each side of the sagittal suture (fig. 4, 7). A vacuity is present between the exoccipito-mastoid and the exoccipito-paroccipital sutures; but whether those vacuities (*v*, *v*, fig. 6) would have appeared on the exterior surface of the occiput may be questioned. The circular foramen on each side the basioccipital needs also to be tested by an entire skull.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 109. The skull, fore part of the vertebral column, scapulæ, with portions of an episternum and of a right humerus of *Kistecephalus microrhinus*: Plate LXIX. figs. 7–10. These parts were worked out of the same block of matrix.

The skull is in a similar condition to that of S. A. 108. Much of the outer bony wall is wanting; but so much of the cranial characters as are exemplified agree with those noted in the preceding description. A transverse fracture has separated part of the outer from the inner walls of the broad, vertical, occipital region of the skull. The proportions contributed by the occipital elements to the vertically oblong foramen magnum are indicated; but the discrimination of suture from fracture is dubious. The scapula (Plate LXIX. figs. 8, 9), 1 inch 4 lines in length, has a basal breadth of 6 lines, which gradually contracts to a breadth of 2 lines at the "neck;" this again expands to an articular end (*d*) of 3 lines breadth. At 3 lines distance from this end a short "acromial" process (*e*) is sent off from the fore border, which marks the length of the neck of the scapula. Overlying, or anterior to, the acromion is the lateral (upper or outer) end of a branch of the episternum (*h*). The humerus (fig. 8, 52) shows a proximal breadth of 7 lines, due chiefly to a delto-pectoral plate. Eleven lines length of the bone is preserved; and the fractured end shows a notch, seemingly due to an entepicondylar canal.

A vertical longitudinal section of two vertebræ (fig. 10) shows the conical form of the terminal surfaces of the centrum, with the apices of those articular cavities almost meeting. The vertical diameter of the neural canal is two thirds that of the centrum. Overlapping parts of the neural arch are seen (as at *n s*, fig. 10, Plate LXIX.).

From Stylkrantz, Sneewberg mountain-range, South Africa.
W. Guybon Atherstone, M.D. [P.].

* Gr. κίστη, box; κεφαλή, head.

Species *Kistecephalus leptorhinus*, Ow.

No. S. A. 110. A nodule of the dark-coloured triassic matrix, moulded upon the interior of a mutilated skull. It is the subject of figures 1, 2, & 3 of Plate LXIV.

It is chiefly remarkable for the contrast, in proportion and position, between the large size and wide separation of the orbits, and the close approximation of the small nostrils (fig. 3, *n*, *n*) at the under and fore part of the skull.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Kistecephalus chelydroides*, Ow.

No. S. A. 111. A nodule of the dark-coloured triassic matrix, with a mutilated skull. It is the subject of figures 8 & 9, Plate LXIV.

As much as remains of the osseous substance shows the same general proportions and characteristic lateral swelling of the parieto-mastoid regions (fig. 8, 7, 8), and a similar vertically elongate form of the foramen magnum (fig. 9, *f*) and of the expanded tympanic (ib. 28) as in *Kistecephalus microrhinus*; but the orbits (*o*) and interorbital tract of the frontals (11) are relatively less, and the temporal fossæ larger, than in the type species. The exoccipitals (fig. 9, 2) surround the foramen magnum and exclude the superoccipital (3) from its upper border (as in No. S. A. 108). The transversely elliptical vacuities (fig. 9, *v*) between the mastoid (8), ex- (2) and paroccipitals (4) are here repeated, but of larger relative size; the circular foramen (*j*) on each side of the basioccipital also here appears. The nasal end of the cranium has been broken away; but it seems, from the remaining cast by matrix of the nasal cavities (fig. 8, *n*), to have been short and narrow.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Kistecephalus planiceps*, Ow.

No. S. A. 112. A nodule of triassic claystone, with the inner table of the walls of the skull, wanting the lower jaw. The specimen is the subject of figures 10–13, Plate LXIV.

The transverse contour of the walls of the cranium proper is flatter, less convex than in the previously described species. The occiput is broader, and has a subquadrate form. The proportions and position of the orbits are nearly those of *Chelydra serpentina*; but the nostrils, though approximate, are divided, as in the rest of the genus *Kistecephalus*.

A tendency to the extreme modification of the cold-blooded vertebrate series manifested by the order Chelonia is plainly discernible in the subjects of Plates LXIII. and LXIV.; but the biconcave trunk-vertebræ, scapula, and humerus adhere to the oudenodont type.

From Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

Species *Kistecephalus arctatus*, Ow.

No. S. A. 113. A cast of a nodule of triassic claystone, with the inner table of the skull, including part of the lower jaw. The original is figured in Plate LXV. figs. 2–6.

This species has a narrower cranium and interorbital tract of the frontals than *Kistecephalus planiceps*. The orbit (*o*) is longitudinally elliptical; the nostrils (*n*) have the generic size and position (comp. fig. 5 with fig. 7, Plate LXIV.). The dentary element of the mandible (figs. 3 & 4, 32) is devoid of teeth, and is deep in proportion to its length, with the fore part of the symphysis broad and upcurved in advance of the caniniform productions of the maxilla. These (*c*, *c*, figs. 3, 4, & 5) descend outside a depression between the symphysial and postero-superior border of the dentary. The posterior border of this element is broadly and deeply emarginate.

The original, from a locality not noted in South Africa, is in the Albany Museum, Cape of Good Hope, and was transmitted by the Direction of that Museum for the present determination and description.

No. S. A. 114. A block of triassic matrix, with an impression and parts of the inner table of the upper wall of the skull of *Kistecephalus arctatus*: Plate LXV. fig. 1.

From the triassic deposits at Stylkrantz, Sneewberg mountain-range, South Africa.
W. Guybon Atherstone, M.D. [P.].

Species *Kistecephalus bathygnathus*, Ow.

No. S. A. 115. A nodule of triassic claystone, with a mutilated skull and lower jaw, of which a left-side view is given in fig. 7, Plate LXV.

This skull has been subject to some distortion through posthumous pressure, but not such as to affect the vertically elliptical form of the orbit (*o*), the arched upper contour of the temporal fossa (*t*), or the depth of the mandibular ramus (32). The lower jaw has been pushed a little backward; the broad, produced, and depressed, rounded, lamelliform alveolar end of the symphysis of the dentary (32) is thus brought beneath, instead of being in advance of the caniniform productions of the upper jaw (*c*). The abrasion of the outer surface of the mandibular ramus exposes the splenial element (31′) and shows the vacuity between it and the upper posterior branch of the dentary; a part only of the angular element (30) is preserved. The parietal tract of the cranium is transversely concave; in the mid line opens the foramen parietale. The left tympanic with the paroccipital abutment is well shown.

From the triassic deposits at Stylkrantz, Sneewberg mountain-range, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

‖ *Loc. cit.*

Fam. ENDOTHIODONTIA.

Genus Endothiodon*, Ow.

Species *Endothiodon bathystoma*, Ow.

No. S. A. 116. A cast of the fore part of the skull and corresponding part of the mandible. The original is figured, of the natural size, in Plates LXVI. & LXVII.

The absence of teeth or sockets in the alveolar borders of both upper and lower jaws, and the production of part of that of the upper jaw (Plate LXVI., *c*) beneath the nostril (ib. *n*) were obvious characters suggesting a reference of the specimen to the "Oudenodont" family of the Anomodontia.

A section was made across the caniniform production (along the line indicated, Plate LXVI., *c' c'*), which exposed merely the close or dense osseous texture of the part and the line of union between the maxillary and premaxillary (Plate LXVII. fig. 6).

In the short vertical diameter of the orbit (Plate LXVI., *o*) there was a resemblance to the *Oudenodon prognathus* (Plate LXI. fig. 1, *o*). But the proximity of the nostril to the fore end of the skull, and the relative distance between the nostril and orbit, differentiated the present fossil from previously defined species of *Oudenodon*.

The skull had been crushed by posthumous pressure; and the parts were kept together by the hard matrix; but the success in relieving this from the exterior surface encouraged the attempt to expose the palatal characters of the upper jaw, with a view to further insight into the affinities of the fossil.

The result was the demonstration of the integrity of the fore part of the roof of the mouth (Plate LXVII. fig. 1), of the median rising, further back, due to the vomer (ib. 13), and of the single median palato-pterygoid vacuity (ib.). Faint indications of small, round, scattered teeth next attracted notice; and horizontal sections were taken to determine the nature of this appearance. The results are faithfully given in figures 1 & 4, Plate LXVII. Many such small round or cylindrical and seemingly obtuse teeth, slightly varying in size, were demonstrated, implanted irregularly on parts of the palatal surface of the maxillary and palatine bones. No such teeth were detected on the alveolar borders of the maxillaries and premaxillaries.

Attention was next directed to the opposing surfaces of the thick rami of the lower jaw; and the indications there of denticles were similarly tested by transverse sections of those surfaces. They were not found in the alveolar groove (ib. figs. 2 & 5, *a*) nor in its outer wall, but in the unusually thick, inwardly extended or inner boundary of that groove (ib. *b*). A vertical transverse section of the mandibular ramus was next made (ib. fig. 5); and on the inner side of the tooth which had risen into place (ib. *c*) a successor (*d*) was exposed, with the apex of the crown protruding from a formative alveolar depression (*e*) on the inner side of the thick upper border of the mandibular ramus.

The symphysis of this ponderous lower jaw is consolidated by bony confluence of the rami. The fracture which it has sustained near the apex, which probably curved upward when entire, exposes the dense bony texture of the part (Plate LXVII. figs. 2 & 3, *s*).

The limitation of teeth to the palate and corresponding inner border of the broad alveolar surface of the mandible recalls a dental character of a genus of extinct reptile (*Placodus*) from European trias.

The original, from a triassic deposit in the Sneewberg range, is now in the Museum of Albany, Cape of Good Hope, and was transmitted by the Direction of that Museum for the present determination and description.

No. S. A. 117. Sections of portions of the palate and mandible from the above-described specimen of *Endothiodon bathystoma*.

* Gr. ἔνδοθι, within; ὀδούς, tooth.

series is 3 inches 8 lines; the length from the hind end of the exposed palatal bone to the incisor-impressions is 5 inches. The alveolar series gradually converge forward along two thirds of their extent,

Subclass **DIPNOA.**

Order LABYRINTHODONTIA*.

Section ÆQUIDENTICULATA.

Fam. COCCOGANOIDEA.

Genus PETROPHRYNE†, Ow.

Species *Petrophryne granulata*, Ow.

No. S. A. 118. A cast of the skull. The original specimen is figured, of the natural size, in Plate XX. figs. 13, 14, and with portions magnified, figs. 17–20.

A great proportion of the exoskeleton is preserved, connate with the endoskeletal bones or represented by their outer layer of ganoine. This does not show the pattern of "wrinkles radiating from centres," as in the rytidoganoid Labyrinthodonts (*Brachyops*, e. g., from the Palæozoic beds at Mángali, Central India‡), but the closely granulate surface of the family, of which *Rhinosaurus* § is the type.

Linear grooves, *quasi* sutures, define a pair of unequal superoccipitals (Plate XX. fig. 13, 3, 3), mastoids (ib. 8, 8), and an undivided, or less definitely divided, parietal (ib. 7), perforated near its fore part by a small, well-defined, subcircular "foramen parietale" (ib. fig. 18, 7′). External to the parietal, on each side, is a large supertemporal (ib. *t*, *t*), a postfrontal (ib. 12), a malar (ib. 26, fig. 14), and a squamosal (ib. 27).

Between the tympanic (ib. fig. 14, 28) and the mastoid (ib. 8) is a large semicircular space indicative of a "meatus auditorius externus," or place of attachment of a "membrana tympani" (ib. *au*). The orbits (ib. figs. 13, 14, *o*, *o*) are subtriangular, the angles broadly rounded off so as to approach the subcircular form; they are situated in the anterior half of the space between the occiput and the end of the snout, and are separated, above, by a frontal (ib. 11), which there has a breadth equal to that of the orbit. This cavity is bounded beyond by the postfrontal and malar, above by the frontal, beneath by the maxillary (21), in conjunction with the lacrymal (73) and malar (26), in front by the lacrymal and prefrontal (14). The lacrymal may be traced to the hind border of the external nostril. These nostrils (ib. *n*, *n*), of subcircular form, are divided by a pair of nasals (ib. 15), rather broader than the interorbital frontal. The premaxillary (ib. 22), maxillary (ib. 21), and lacrymal (73) complete the periphery of the nostril.

The mastoid angles (8, 8) terminate $\frac{1}{8}$ of an inch in advance of the base of the occiput. With the owner's permission, sufficient of the matrix (a hard reddish sandstone) was removed to expose the pair of occipital condyles (ib. fig. 16, 2, 2), the subdepressed form of which resembled those in *Brachyops laticeps*‖. Behind these were portions of cervical vertebræ, with short, straight, slender ribs, slightly expanded at their capitular end.

The mandibular ramus articulates by a concave surface (ib. fig. 17, 29) with the tympanic (ib. 28),

* Anatomy of Vertebrates, 8vo, 1866, vol. i. p. 14. † Gr. πέτρος, rock; φρύνη, toad.

‡ Quarterly Journal of the Geological Society, vol. xi. 1855, p. 37, pl. ii.

§ Described and figured by Fischer v. Waldheim, in the 'Bulletin de la Société Imp. des Naturalistes de Moscou,' tom. xx. 1847, p. 1, tab. i.

‖ *Loc. cit.*

Fam. ENDOTHIODONTIA.

which bone extends backward beyond the mandible and bends a little upward to contribute to the frame of the ear-drum (ib. fig. 14, *au*).

The matrix between the dentary (ib. fig. 15, 30) and angular (ib. ib. 32) elements may have been exposed by removal of osseous substance (as at *m*). The entire ramus shows little depth, and becomes slender as it advances forward.

The teeth in both upper and lower jaws are numerous, close-set, subequal, minute, slender, and conical. They are stronger in the upper jaw (ib. fig. 19) than in the lower (ib. fig. 20). Not any tooth is markedly larger than the rest, as is the case at the fore part of the series in the tusked family of Labyrinthodonts. In this character, as in the general form, *Petrophryne* agrees with *Brachyops*, *Rhinosaurus*, and *Micropholis*. There is no evidence in the present specimen of a scutulate tegument, as in *Micropholis Stowii**, Huxley, or in *Rhombopholis scutulatus*†; and no scutes appear to have been associated with the skull of *Rhinosaurus Jasykovii*‡.

From the triassic sandstone of the "Tafelberg, Queenstown district," Cape of Good Hope.

The original, from which the above description and figures were taken, was submitted to the writer for that purpose, with leave to take a cast, by its discoverer, W. Guybon Atherstone, M.D., F.G.S.

Species *Petrophryne* (?) *major*, Ow.

No. S. A. 119. A slab of yellowish sandstone, containing impressions of the dental series, with small portions of the contiguous alveolar plate of the upper jaw.

Impressions of the crowns of about sixty small, conical, subequal teeth may be counted on the preserved border. The small portions of bone extending from near the hinder ends of the alveolar borders are of the inner layer of the wall of the skull, and indicate, by their feeble rise as they extend inward, the low, almost flattened, form of the maxillary part of that wall. This indication is supported by the smoothness of the upper surface of the cast, and the evidence it gives, near the fore end, of a pair of small cavities or openings, agreeing in position with those of the external nostrils in *Petrophryne*. The removal of the back part of this cast, to a depth of 4 lines, brings into view a median bone of the skull, basal or palatal, about half an inch in breadth. The length of nearly an inch of this bone is thus exposed, and the shallowness of the cavity between the naso-maxillary roof and the palatal floor of the facial part of the skull is indicated. The breadth of this part of the skull at or near the hind ends of the dental

* Quarterly Journal of the Geological Society of London, vol. xv. 1859, p. 642, pl. xxi. fig. 7.

† Owen, 'Transactions of the Geological Society,' 2nd series, vol. vi. 1841, p. 538, pl. xlvi. fig. 5.

‡ *Loc cit.* Of this skull the dermosteal surface ("épiderme") is described as "plutôt chagrinée ou granuleuse qu'écailleuse, les graines, presque réguliers sur les frontaux et les nasaux, prennent une forme alongée et presque rayonnante sur les pariétaux et les temporaux" (ib. p. 5). This skull is 3 inches 6 lines in length. If it is preserved in the Museum of the Imperial Society, it would be instructive to expose the occipital articulation, of which it is stated, "Les vertèbres attachées au crâne sont trop empâtées dans la matrice pour en indiquer la forme" (ib. p. 7). Other fossils collected by M. Jasykou and described in the same paper as "jurassic" are positively and correctly referred to that formation; but with respect to the labyrinthodont skull the reference is given with an expression of doubt. A communication has been made to the Imp. Naturalists' Society of Moscow suggesting the desirability of this doubt being dispelled, and the true locality and formation which yielded the "*Rhinosaurus*" of Fischer being, if possible, determined.

With respect to the *Micropholis Stowii*, should a better-preserved specimen be discovered showing the granulate ganoine of the cranial bones, seemingly wanting, and should a specimen of *Petrophryne granulata* be discovered with the rhomboidal and triangular scutules, the correspondence in size and general form of the skulls is so close as to indicate them to be of the same species; and, with a proved concurrence of the dermal characters, now apparently distinct, and of the double occipital condyle, the genus *Petrophryne* must sink into a synonym of *Micropholis*.

series is 3 inches 8 lines; the length from the hind end of the exposed palatal bone to the incisor-impressions is 5 inches. The alveolar series gradually converge forward along two thirds of their extent, and then rapidly incurve to define a muzzle of parabolic contour. The muzzle may perhaps have been a little narrower relatively than in *Petrophryne*; but the general resemblance in the shape of this part of the skull is close.

From the shape of the skull thus indicated, and from the relative size, number, and juxtaposition of the teeth, a species of Labyrinthodont, of the canineless section of that order, about the size of *Baphetes planiceps* †, is indicated.

From the southern margin of the Stormberg range.
The Geological Society of London [P.].

Genus Batrachosaurus‡, Bain (MS.).

(*Saurosternon*, Huxley.)

Species *Saurosternon Bainii* §, Huxley.

No. S. A. 120. A slab of petrified shale, with portions and impressions of the bones of the trunk, tail, and parts of the fore and hind limbs.

From the triassic deposits at "Stylkrantz, Sneewberg mountain-range," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 121. A smaller portion of the same matrix, with parts and impressions of the skull, anterior vertebræ, and episternum: Plate LXX. figs. 3, 3*.

The episternum (fig. 3, *h*) shows the clavicular groove on each transverse branch, as in that of *Labyrinthodon leptognathus* ‖; but the fore border presents a feeble convex curve, without the median notch.

The skull presents the parabolic outline, or half of a long ellipse, which characterizes the shape of that of the preceding labyrinthodont genus. As in that also it is depressed, with maxillary and mandibular bones of very slight vertical thickness, and armed with numerous, close-set, slender, conical, and sharp-pointed teeth, slightly concave inward and backward; they are ankylosed to distinct, though shallow, alveoli. The angular element of the mandible is not produced backward, as in Lacertilia, beyond the tympanic.

Amongst the characters of the Labyrinthodont Reptilia, especially those in which they differed from the Batrachia, noted in the 'Transactions of the Geological Society,' 2nd series, vol. vi. (1841), are:—the long and curved ribs (p. 540); the hind limbs twice as long and as strong as the fore limbs, the tibia as long as the femur, but the astragalus and calcaneum not long and slender (p. 339); finally, the T-shaped episternum, with the clavicular groove in each cross bar (p. 524, pl. 45. figs. 9, 10).

† Quarterly Journal of the Geological Society, vol. x. 1854, p. 207, pl. ix. The original of this description is a Labyrinthodont from the carboniferous formation at Pictou, Canada.

‡ Catalogue B, no. 57. This generic term, having been applied by Fitzinger, in 1839, to a Labyrinthodont genus, gives place to the synonym above cited.

§ Geological Magazine, vol. v. 1868, p. 201, pl. xi.

‖ "Description of Parts of the Skeleton &c. of Species of the Genus *Labyrinthodon*," Trans. Geol. Soc. *tom. cit* p. 524, pl. xlv. figs. 9 & 10.

The molar series is arranged, and, as it seems, naturally, along a curved convex line, in which the

These evidences of agreement with the Labyrinthodonts leads me to concur with Bain's idea of the affinity of these fossils, expressed by his generic term, and to reject their reference to a lacertilian or saurian order.

The lacertian modification of the cold-blooded air-breathing quadrupeds, by which modification these are now most numerously represented, appears not to have been established, at least not indubitably recognizable by the present writer, until toward the close of the Secondary or Mesozoic period. Any fossil manifesting characters of an earlier type (episternum, *e. g.*) which have been retained by modern Lizards, and combining, as in *Pleurosternon*, those characters with others, lost in the lacertian order but common in Reptilia of the older Mesozoic and newer Palæozoic periods, may be, with more probability, referred to the order Labyrinthodontia.

From a triassic deposit at "Stylkrantz, Sneewberg range," South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].

SUPPLEMENTARY SPECIMENS*.

Order DINOSAURIA.

Species *Pareiasaurus serridens*.

No. S. A. 122. The left ilium.

This bone accords with the type of that in Crocodilia and Dinosauria in its production forward in advance of the acetabulum, as well as in its greater extension backward. The acetabular portion is supported on a constricted part or neck, and, besides the concave articular part for the head of the femur, shows two flattened syndesmotic surfaces—one for the pubis, and one for the ischium—in this respect differing from the Crocodile. The outer surface of the ilium is slightly concave and smooth; the opposite surface is convex, irregular, and roughened by syndesmotic impressions indicative of four or more sacral vertebræ, to the ribs of which it was attached.

From a triassic (?) formation "near Sola's Kraal," Caffraria.
Andrew Geddes Bain, Esq., F.G.S. [P.].

* These have been wrought out since the foregoing sheets were printed off.

distinct, and of the double occipital condyle, the genus *Petrophryne* must sink into a synonym of *Anthrophoris*.

the fracture suggests must have descended to completely overlap the mandible or attain the level of its lower border, as has evidently been the extent and relative position of the canine in *Lycosaurus tigrinus*

Species *Anthodon serrarius*.

No. S. A. 123. A portion of matrix, with three mutilated trunk-vertebræ. A section of one of these is figured in Plate LXX. fig. 2.

This fossil is entered in the MS. list of the Donor as "Vertebræ and dermal bones of the small Blinkwater reptile."

The parts which present the appearance of "dermal bones" are the anterior articular processes (zygapophyses), which are broad, convex above, and terminally rounded, and at first sight might be taken for part of a series of lateral dorsal scutes. These processes are given off from the fore part of a neural arch, unusually broad in proportion to its length and height. The vertical diameter of the centrum is small in proportion to the breadth and length. A vertical longitudinal section through the middle of the centrum exposes an unusually deep conical cavity, of which the base occupies nearly the whole of the terminal surface, and the apex meets that of the opposite cone, with but half a line's interposition of osseous substance. This, which is minutely cancellous at the surface of the articular cone, shows a loose or open texture in the rest of the centrum, the large cancelli being bounded by fine longitudinal osseous lamellæ.

As this type of vertebræ differs from that in *Pareiasaurus* and *Tapinocephalus*, as well as from that in the theriodont and anomodont Reptilia, I have the greater confidence in referring it, with Mr. Bain, to his "smaller Blinkwater reptile" (S. A. 30), which is the type of the genus *Anthodon*. The present is the sole example which has come under my observation of a Dinosaurian reptile with vertebræ bicoconcave, as in *Icthyosaurus* and in fishes. Nevertheless, in the proportion of the peripheral part of the terminal surfaces of the centrum, which preserve a flatness or even convexity before the concavity commences, there is an approach to the tretospondilian type which I have not seen in any Ichthyosaur. This structure may bear some relation to the early geological period of the existence of the genus *Anthodon*.

The locality is noted as "Stylkrantz, Sneewberg."
Andrew Geddes Bain, Esq., F.G.S. [P.].

Order THERIODONTIA.

Species *Lycosaurus curvimola*, Ow.

No. S. A. 124. The skull, mutilated: Plate LXVIII., nat. size.

This fossil includes the nostrils with their narrow septum (fig. 3, *n*, *n*), the upper jaw, with the fore part of the right orbit (fig. 1, *o*), the symphysis (fig. 4), and right dentary element (fig. 1, 32) of the mandible. The latter retains its natural position as in the shut mouth; and its teeth and alveolar border are overlapped, as in similar remains of the other Theriodonts, by the corresponding parts of the upper jaw. Consequently the dentition of this jaw only is exposed. Its formula is

$$\text{I.}\ \frac{4—4}{\quad}, \text{C.}\ \frac{1—1}{\quad}, \text{M.}\ \frac{5—5}{\quad}\ \text{or}\ \frac{6—6}{\quad}.$$

The molar series is arranged, and, as it seems, naturally, along a curved convex line, in which the

These evidences of agreement with the Labyrinthodonts leads me to concur with Bain's idea of the affinity of these fossils, expressed by his generic t[illegible] to point their reference to [illegible]

crowns of five teeth are clearly shown; a sixth doubtfully; these are in the right, and best-preserved, portion of the maxillary (fig. 1, *m*, 1, 2, 3, 4, 5). A fragment of the left maxillary (fig. 2, 21), broken off from the rest of the skull and pressed outward, lay near the surface of the block of matrix; and small portions of the enamelled crowns of teeth in this fragment appear to have attracted the attention of Mr. Bain, and to have led to the fortunate preservation and transmission of the otherwise unpromising mass of matrix, which he has entered in his list as "No. 72, Saurian head, with very fine teeth;" five of these left molars have been exposed as clearly as their condition permits. The best-preserved right molars have conical, subcompressed, slightly recurved crowns, with an obtuse anterior border and a trenchant and finely serrate posterior border. The enamelled crown of one of these teeth is figured, magnified three diameters, in fig. 5.

The anterior molar (fig. 1, *m* 1) projects from its alveolus at an interval of 4 lines (8 milimetres) from the canine (*c*); its apex is directed more backward than in that tooth. The second molar emerges with an interval of about 1 line from the first; but its crown inclines a little more backward. The third molar, issuing at a shorter interval, has a similar direction of its crown. Then comes an interval of 3 lines between the third and the fourth molars in place, in which interval there is no trace of tooth-base or of socket. The fourth tooth has a similar direction of crown to the second. The portion of the broken fifth molar is about a line's distance from the fourth. The more dubious indication of a sixth molar (*m*) is at a further distance; but here the outer wall of the alveolar part of the maxillary becomes too much mutilated for profitable description. The part containing the exposed enamelled crowns of the four anterior molars shows the natural curvature of the alveolar line of the upper jaw.

The crowns of these teeth are closely applied to the outer surface of the alveolar border of the corresponding part of the mandible; and it seemed not advisable to meddle with or remove them for the chance of exposing mandibular teeth which they might conceal. The matrix is represented of a light tint in the plate, to relieve the crowns of the upper molars.

The length and direction of these sharp-pointed laniariform crowns show adaptation to retain and prevent the escape of an active struggling prey; and the like general direction of the longer and larger crowns of the canines and incisors would more effectually concur in this act.

The canine tooth, better preserved on the left (fig. 2, *c*) than on the right side, shows an enamelled crown 1 inch in length and 5 lines in the longest diameter of the base; but the apex is wanting. The part of the fore margin preserved is narrow but blunt, and slightly curved lengthwise; the sharp and almost straight hind border is finely serrate. The sides of the crown are not parallel with those of the jaw, but seem as if the tooth had been a little twisted on its axis, so as to turn the fore border rather outward, the hind border inward. The twist is rather more marked than in *Lycosaurus tigrinus*. An interval of half an inch divides the base of the canine from that of the fourth or outermost incisor.

The crowns of these teeth (*i* 1, 2, 3, 4) are slender, conical, subincurved, less compressed and longer in proportion to their breadth than the molars. They are eminently prehensile. The apex in each is lost by fracture or abrasion; in one, the first or foremost of the left side, such abrasion seems to have been natural and due to some friction obliquely affecting the fore or outer part of the apex of the tooth. If this is due to the opposing action of a lower incisor, it implies free movements of protrusion and retraction of the mandible, in addition to the vertical movements for biting.

The symphysial part of the mandible is exposed, at the intervals between the canines and incisors, as far as the level of the alveolar border of the upper jaw, without bringing into view the bases of the lower canines. It thus gives the depth or vertical extent of the outer surface of the fore part of the symphysis, 2 inches 7 lines (fig. 4, *s*); the same dimension of the lower jaw of *Lycosaurus tigrinus* (S. A. 34) is 2 inches 2 lines.

The slope of this part of the symphysis in *Lycosaurus curvimola*, from above downward and backward, is straighter and greater, or the chin is more receding, than in *Lycosauras tigrinus*. The seemingly longer and larger canines in that species have their apices, the mouth being closed, on the level or transverse parallel of the lower and hinder border of the symphysis, mandibulæ. In *Lycosaurus curvimola* the apex of the canine, the mouth being closed, reaches little more than halfway toward the lower border of the symphysis, and is on a transverse parallel with the symphysis, nearly 1 inch in advance of the lower and hinder border. Considerably more of the apical part of the crown of the canine than

the fracture suggests must have descended to completely overlap the mandible or attain the level of its lower border, as has evidently been the extent and relative position of the canine in *Lycosaurus tigrinus*.

After some loss of vertical diameter beyond the symphysis, the mandibular ramus gains in depth, and the upper branch of the dentary rises to contribute to a large and lofty coronoid process (fig. 1, *r*).

Some indication of the size of the temporal fossa lodging the muscular mass inserted into that process is left where the posthumous forces which have removed the outer part or walls of the postorbital portion of the skull have ceased to operate (as at *t*, *t'*, fig. 1). On this abraded surface the outer condyle of the articular end of the tympanic (28), and the corresponding concavity of the co-articulated mandible (29), appear to be traceable. The angular extension behind this joint has been broken away. A greater proportion of the left mandibular ramus is wanting. Along the middle of the outer surface of the hinder half of the ramus the bone is strengthened by a low broad rising.

The septum dividing the external nostrils (*t*, fig. 1 & fig. 3) rises from the incisive alveoli with a forward slope before gaining by an obtuse backward curve the upper surface of the skull. The thickness of the septum is 3 lines; its forward extension gives an obliquely outward aspect to the bony nostrils (*n*); these are vertically oval, with a long diameter of 8 lines. From the fore border of the septum to that of the orbit is 3 inches 8 lines. The total length of the skull may be estimated at 8 inches.

The mutilated evidences S. A. 32, 33, 34 (pp. 15–17) of the present extinct genus gave the doubtful indications of the incisive formula noted at p. 17. The subsequent relief from an unpromising nodule of matrix of the present rare and instructive fossil supports the generic maxillary dental formula—

$$\text{I.}\ \frac{4—4}{\text{——}},\ \text{C.}\ \frac{1}{-},\ \text{M.}\ \frac{5\ \text{or}\ 6}{\text{——}}?$$

From a triassic formation on "the Kuga Berg, near Stewart's Farm."
Andrew Geddes Bain, Esq., F.G.S. [P.].

Order ANOMODONTIA.

No. S. A. 125. A rolled and waterworn portion of a sacrum of an Anomodont reptile.

It includes four vertebræ, showing a cast in matrix of the neural canal and nerves issuing therefrom. From this it may be inferred that the myelon expanded in the second and third of these sacrals, and contracted more suddenly, and in a greater degree, at what appears to be the caudal end of the sacrum.

From triassic deposits at Kaffirland, opposite Mildenhalls.
Andrew Geddes Bain, Esq., F.G.S. [P.].

No. S. A. 126. A mass of matrix, including part of the sacrum and pelvis, with ten anterior caudal vertebræ, of an Anomodont reptile, probably a species of *Dicynodon* (woodcut, p. 74).

The centrum of the anterior caudal, 1 inch 2 lines in length, 2 inches in breadth where joined by the neural arch, narrows to the under surface, and slightly expands to the terminal articular surfaces. The base of the transverse process extends from that of the neurapophysis, above which the arch is broken off.

In the second caudal about an inch and a half of the left transverse process is preserved; it projects outward with a slight bend. The upper surface is convex both across and lengthwise, and the transverse convexity is continued in the neural arch to the base of the spine, which is broken off. The third caudal has a shorter transverse process inclined more backward; in the fourth it is reduced to a stump, and in the

fifth has disappeared. A pair of small hypapophyses at the hind border of the under surface of the fourth caudal indicates the first hæmal arch to have been at the interspace between this and the fifth caudal. In this vertebra the præzygapophyses and base of the neural arch are preserved. The hypapophyses are larger; and part of the coalesced hæmal arch is attached to the right one. In the sixth caudal the anchylosed hæmal arch is retained, with the broken spine. The transverse process is reduced to a stump. The vertebræ here begin to lose in breadth and length while gaining in depth.

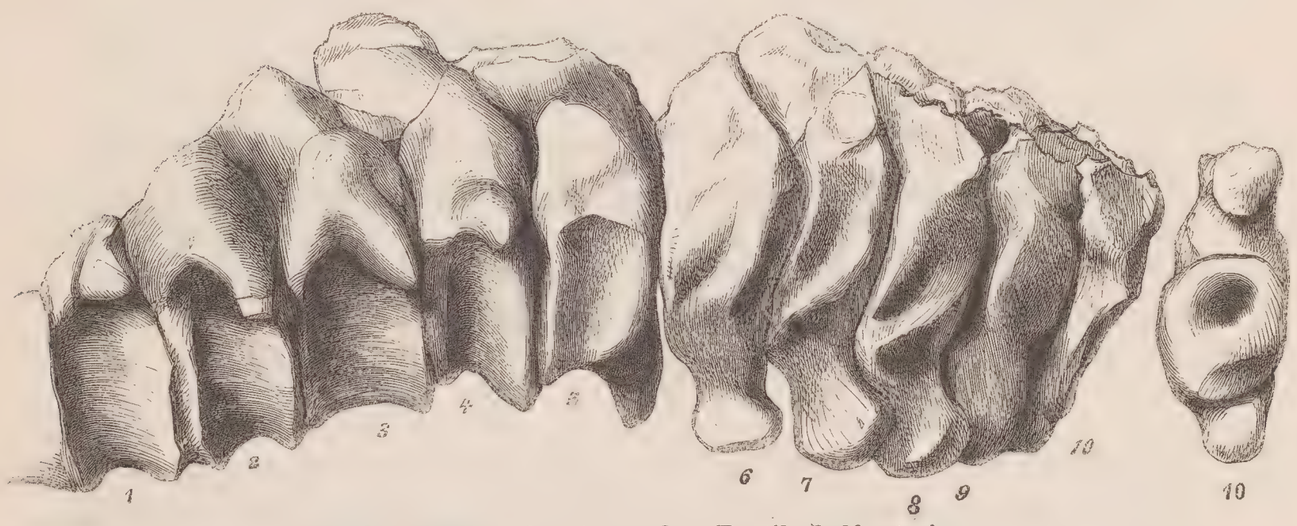
In the seventh caudal the gain of vertical diameter and loss of longitudinal and transverse dimensions are more marked. In the three following vertebræ the decrease of length and breadth is attended with that of height, and with the suppression of transverse processes to the end of the tail.

The length (antero-posterior diameter) of the tenth caudal is 7 lines; the transverse diameter is 1 inch 3 lines; the vertical diameter of the centrum is 1 inch 4 lines, that of the entire vertebra, minus the neural spine, is 3 inches: the same diameter of the seventh caudal is 4 inches 3 lines.

The hæmal arches articulate with the whole fore-and-aft extent of the under surface of the centrum in the last four vertebræ of the present species.

The five terminal vertebræ indicate their relation as supports of a compressed natatory tail. The entire tail, at the rate of decrease indicated, may have included from fifteen to twenty vertebræ. The antero-posterior diameter of the ischio-pubic part of the pelvis is 5 inches; the length of the ischium, which is 7 inches, equals that of the six anterior caudal vertebræ, which may be reckoned to be about one half of the entire length of the tail. This, therefore, was shorter relatively than in modern Crocodiles and Lizards.

From a triassic deposit near Fort Beaufort, South Africa.
Andrew Geddes Bain, Esq., F.G.S. [P.].



Caudal vertebræ of an Anomodont Reptile, half nat. size.

SUMMARY.

When we contrast the grand development and notable modifications of form and structure in the extinct members of Reptilia with the poor scanty evidences of the class lingering on in life, we seem to be witnessing a course of degeneration, of retrogradation, rather than one of organic progression in the tract of time.

Although there be none now, there have been Saurians in which the articular surfaces of certain vertebræ in the same column were modified (as, *e. g.*, the anterior ones of great herbivorous Dinosaurs) for freer movements of the head, by the play of an anterior ball in a posterior cup, such as we now find in the Rhinoceros and some other large mammalian herbivores. In another part of the same vertebral column we find a sacrum not limited to two but composed of five or six anchylosed vertebræ, also as in the herbivorous and many other Mammals.

Again, some of these vegetarian Dinosaurs had masticatory teeth of a complex structure* unknown in existing phytophagous Sauria, but resembling those of certain phytophagous Mammals (*Megatherium* †, *Mylodon* ‡, e. g.). With a portion of the dental tissue of each tooth, modified by retention in the dentine of subparallel vascular canals, is associated a downward development of the zygomatic arch for extending the origin and augmenting the size and force of the masseteric or masticatory muscles.

This structure, unknown in any existing reptiles, but exemplified in *Iguanodon, Scelidosaurus, Pareiasaurus, Anthodon,* reappears, so to speak, in certain Mammalia—and here in members of the class which by their low position according to cerebral characters, with genital and other concomitant modifications, show a near approach to the cold-blooded Ovipara; the Sloth and Kangaroo are examples. But cranial characters of lack, as well as of gain, are not wanting to this comparative survey. The lingering evidence, in reptiles, of vegetative repetition, as manifested by multiplied centres of ossification in the facial blastema, has disappeared. The "ectopterygoid" ceases to exist in both Therio- and Anomodonts. That bone never reappears in the mammalian series; and its absence has been hitherto regarded as a distinctive osteological character between the saurian and mammalian air-breathing quadrupeds.

In no existing Reptilia is the principle of differentiation of structure, adapting particular teeth for special functions, exemplified as it is in the extinct Theriodonts. Not until the discovery of members of this order of Reptilia could the anatomist specify incisors, canines, molars, in the dental series, on characters of size, shape, and relative position, with the same certainty, or on as satisfactory grounds, as in the warm-blooded quadrupeds. With

* Odontography, p. 250, pl. 71, 4to, 1840. † Ib. pl. 84. ‡ Ib. pl. 79.

the carnivorous type of incisors, canines, and molars, we now have evidence of an associated humeral structure (S. A. 40), unknown in any Lacertian or other existing reptilian fore limb, but a structure reappearing in certain mammals, and notably in the implacental group of Marsupialia and in the ovo-viviparous Monotremes.

In one of the species of Saurians, with what now is a mammalian type of humerus and of dentition, evidence is afforded (S. A. 89) of the bony structure of the fore paw, which again shows an advance toward the mammalian type. The pollex has two phalanges, the four other digits have each three phalanges. The slight difference of length in these fingers is due, as in a dog's paw, to difference of length in such phalanges; not, as in existing lizards, to difference of number, not to excess in the third and fourth digits beyond the number three—a phalangeal formula which rules in the fingers of all terrestrial mammals.

Reverting to the chief character of the Theriodont reptiles, a fact of some significance may be noted, viz. that the incisive formula of some of the species is repeated in low marsupial genera of Mammalia. *Didelphys* has $i.\frac{5—5}{4—4}$, as in *Cynodracon*; *Thylacinus* and *Sarcophilus* have $i.\frac{4—4}{3—3}$, as in *Cynochampsa* and *Lycosaurus*. In no placental carnivore do the incisors exceed the formula $i.\frac{3—3}{3—3}$.

In the class of cold-blooded, air-breathing, naked Ovipara, as known to zoology by existing species, the characters above specified are wanting. They would have been utterly unknown and unsuspected as reptilian ones, save for the researches of the palæontologist.

If the gap in the series of animals between the Mesozoic and Psychozoic air-breathers had not been filled up otherwise than by reptiles, the remnant of that class which has survived and reached our times would have testified to total loss of such gains of organization as had enriched the ancestors or predecessors of modern Tortoises, Lizards, and Crocodiles.

We now know that not one of these gains has been lost, but has been handed on, continued, and advanced, through a higher type of Vertebrates, of which type we trace the dawn back to the period when reptiles were at their best—grandest in bulk, most numerous in individuals, most varied in species, best endowed with kinds and powers of locomotion, and with the instruments for obtaining and dealing with both animal and vegetable food.

Has the transference of structures, it may be asked, from the reptilian to the mammalian type been a seeming one, delusive, due to accidental coincidence in animal species independently and thaumatogenously created? Or was the transference real, consequent on nomogeny, or the incoming of species by secondary law, the mode and way of operation of which we have still to learn? Certain it is that the lost reptilian structures specified in the present Catalogue are now manifested by quadrupeds with a higher condition of cerebral, circulatory, respiratory, and tegumentary systems—a condition the acquisition of which is unintelligible to the writer on either the Lamarckian or the Darwinian hypothesis.

DESCRIPTION OF THE PLATES*.

PLATE I.

Tapinocephalus Atherstonii.

Fig. 1. Palatal surface of fore end of upper jaw.
2. Section of fore end of upper jaw.

PLATE II.

Fig. 1. Fragment of fore end of under jaw of *Tapinocephalus Atherstonii.*
2. Horizontal section of alveolar border of *Tapinocephalus Atherstonii.*
3. Section of the tooth *a*, fig. 2, magnified.
4. Fragment of fore part of jaw, with the two long canine teeth, of *Cynodracon major.*
5. Front view of right canine tooth of *Cynodracon major.*
6. Side view of serrate hind border of the same tooth, magnified.

PLATE III.

Tapinocephalus Atherstonii.

Fig. 1. Front view of part of a dorsal vertebra (S. A. 5).
2. Side view of part of the same vertebra.
3. Under view of part of the same vertebra.

PLATE IV.

Tapinocephalus Atherstonii.

Fig. 1. Back view of part of a lumbar or hinder dorsal vertebra (S. A. 9).
2. Side view of the same vertebra.
3. Under view of the same vertebra.

PLATE V.

Tapinocephalus Atherstonii.

Fig. 1. Side view of anterior portion of a sacrum, including parts of the four foremost vertebræ; half nat. size.
2. Under view of the same; half nat. size.
3. Front view of part of an anterior dorsal vertebra; half nat. size.
4. Vertical and longitudinal section of the centrum of a caudal vertebra.

* The letters and numerals are explained in the text. All the figures are of the natural size, save where otherwise expressed.

PLATE VI.

Pareiasaurus serridens.

Right-side view of skull; two thirds nat. size.

PLATE VII.

Pareiasaurus serridens.

Fig. 1. Left-side view of skull; two thirds nat. size.
2. Outline of an unworn anterior upper tooth; nat. size.
3. Outline of a middle lower tooth; nat. size.

PLATE VIII.

Fig. 1. Portion of the right mandibular ramus of *Pareiasaurus serridens.*
2. Vertical transverse section of the same.
3. Front view of fore part of upper and lower jaws of *Pareiasaurus bombidens.*
3*a*. Outline of transverse contour of fore part of the upper jaw of the same.

PLATE IX.

Pareiasaurus bombidens.

Side view of fore part of upper and lower jaws.

PLATE X.

Pareiasaurus bombidens.

Fig. 1. Front view of part of the first cervical vertebra.
2. Back view of the same vertebra.
3. Side view of the same vertebra.
4. Under view of the same vertebra.
5. Upper view of the same vertebra.

PLATE XI.

Pareiasaurus bombidens.

Fig. 1. Back view of centrum and neural arch, mutilated, of a dorsal vertebra.
2. Side view of the same.

PLATE XII.

Pareiasaurus bombidens.

Fig. 1. Front (thenal) view of left humerus; one third nat. size.
2. Back (anconal) view of the same; one third nat. size.
3. Upper (proximal) articular end of the same; one third nat. size.
4. Lower (distal) articular end of the same; one third nat. size.

Fig. 5. Right-side view of skull of *Procolophon trigoniceps*.

Fig. 4*a*. The same, in outline, showing the relative position of its long axis to that of the upper end (fig. 3); due to the twist of the shaft of the bone.
5. Outline of circumference of shaft, between *b* and *e*, figs. 1 & 2.

PLATE XIII.

Anthodon serrarius.

Fig. 1. Left-side view of a skull, wanting both ends.
2. Outline view of portion of mandible of the same, from the inner side.
3. Magnified view of the same portion of mandible.
4. Magnified view of a tooth implanted in the same mandible.

PLATE XIV.

Lycosaurus pardalis.

Fig. 1. Right-side view of mutilated skull.
2. Left-side view of the same skull.
3. Front view of the same skull.
4. Portion of a left upper canine tooth.
5. Portion of right upper jaw, with basal parts of the canine and some succeeding molar teeth.

PLATE XV.

Lycosaurus tigrinus.

Fig. 1. Right-side view of fore part of the skull, mutilated above and below.
2. Left-side view of the same.
3. Front view of the same.
4. Under view of the same.
5. Portion of serrate border of right upper canine; magnified.

PLATE XVI.

Fig. 1. Upper view of fore end of the skull of *Cynosuchus suppostus*.
2. Right-side view of the same.
3. Left-side view of the same.
4. Under view of the same.
5. Front view of the same.
6. Right-side view of fore end of the upper jaw of *Tigrisuchus simus*.
7. Left-side view of the same.
8. Front view of the same.
9. Under view of the same.
10. Upper view of the skull of *Scaloposaurus constrictus*.
11. Under view of the same.
12. Front view of the same.
13. Back view (mutilated) of the same.
14. Right-side view of the same.
15. Left-side view of the same.

PLATE VI

PLATE XVII.

Cynodracon serridens.

Fig. 1. Left-side view of mutilated fore end of the skull.
2. Front view of the same.
3. Upper view of the same.
4. Under view of the same.
5. Fractured portion of right maxilla, exposing the socket and part of the base of the right upper canine.
6. Basal portion of a right upper canine.
7. Mutilated upper incisor, showing a section of the pulp-cavity and implanted base, with that of the enamel-sheath of the crown and its pair of serrate borders.
8. Upper view of the fore part of another skull.
9. Front view of a symphysis mandibulæ, mutilated below, and with the implanted parts and bases of the incisors and canines.
10. Upper view of the same.

PLATE XVIII.

Fig. 1. Upper view of fore end of skull of *Cynochampsa laniarius*.
2. Right-side view of fore end of skull, with part of mutilated mandible of the same.
3. Left-side view of the same.
4. Under view of the same.
5. Front view of the same.
6. Right-side view of skull of *Galesaurus planiceps*.
7. Left-side view of the same.
8. Upper view of the same.
9. Under view of the same.
10. Front view of the same.
11. Back view of the same.

PLATE XIX.

Fig. 1. Front (thenal) view of the left humerus of *Cynodracon major*.
2. Outline of "head" or proximal end of left humerus of *Cynodracon major*. (See Plate II. figs. 4–6, upper canines of this species.)
3. Front (thenal) view of the left humerus of *Galesaurus planiceps*.
4. Proximal end of the same.
5. Back (anconal) view of distal half of the same.
6. Transverse section of shaft, above the entepicondylar canal (*k*), of the same.

PLATE XX.

Fig. 1. Side view of a cast, chiefly in triassic matrix, of part of a mutilated skull of *Nythosaurus larvatus*.
2. Under view of the same.
3. An upper molar, magnified, of the same.
4. Upper view of skull of *Procolophon trigoniceps*.

Fig. 5. Right-side view of skull of *Procolophon trigoniceps.*
6. Left-side view of the same.
7. Front view of the same.
8. Upper view of mutilated skull of *Procolophon minor.*
9. Right-side view of the same.
10. Left-side view of the same.
11. Front view of upper jaw of the same.
12. Under view of lower jaw of the same.
13. Upper view of the skull of *Petrophryne granulata.*
14. Left-side view of the same.
15. Right-side view of the same.
16. Under view, with matrix removed to expose the two occipital condyles, of the same.
17. Articular parts of tympanic and mandible, magnified, of the same.
18. Parietal bones and "foramen parietale," magnified, of the same.
19. Portion of upper jaw and teeth, magnified, of the same.
20. Portion of lower jaw and teeth, magnified, of the same.

PLATE XXI.

Gorgonops torvus.

Fig. 1. Upper view of skull, mutilated at the back part.
2. Under view of "basis cranii," more mutilated.
3. Section of socket of right canine, with part of germ of its successor (c').

PLATE XXII.

Gorgonops torvus.

Fig. 1. Left-side view of skull, wanting the lower jaw.
2. Right-side view of fore half of the same.
3. Front view of the same.
4. Back view of the same.

PLATE XXIII.

Dicynodon lacerticeps.

Fig. 1. Right-side view of skull.
2. Upper view of the same.
3. Back view of the same.
4. Under view of mandible.
5. Front view of mandible, with ends of upper canines (c, c) in outline.

PLATE XXIV.

Dicynodon leoniceps.

Left-side view of skull, wanting the lower jaw ; c', transverse section of upper canine.

PLATE XXV.

Dicynodon leoniceps.

Upper view of skull.

PLATE XXVI.

Dicynodon leoniceps.

Fig. 1. Under view of skull.
2. Back view ; one third nat. size.

PLATE XXVII.

Dicynodon leoniceps.

Fig. 1. Thenal view of proximal portion of right humerus.
2. Fractured end of shaft of the same, showing the entepicondylar bridge (*h*) and canal (*k*).

PLATE XXVIII.

Fig. 1. Outer or acetabular surface of the left os innominatum of *Dicynodon leoniceps*; five elevenths nat. size.
2. Inner or pelvic surface of the same; five elevenths nat. size.
3. Nodule of matrix, with fore part of skull and canine (*c*) of *Dicynodon* (?) *parvidens* ; nat. size.
4. Remains of bones in a vertical longitudinal section of the same nodule.

PLATE XXIX.

Dicynodon Bainii.

Left-side view of skull, wanting the lower jaw ; *c'*, transverse section of upper canine.

PLATE XXX.

Fig. 1. Back view of skull of *Dicynodon Bainii* ; half nat. size.
2. Back view of skull of *Dicynodon tigriceps*; half nat. size.

PLATE XXXI.

Fig. 1. Upper view of skull of *Dicynodon tigriceps* ; one third nat. size.
2. Upper view of skull of *Dicynodon Bainii* ; one third nat. size.

PLATE XXXII.

Fig. 1. Under view of skull of *Dicynodon tigriceps*; one third nat. size.
2. Under view of skull of *Dicynodon Bainii* ; one third nat. size.

PLATE XXXIII.

Dicynodon tigriceps.

Left-side view of skull, wanting the lower jaw ; *c'*, transverse section of upper canine.

PLATE XXXIV.

Fig. 1. Right-side view of mutilated skull and lower jaw of *Dicynodon tigriceps*; half nat. size.
2. Upper view of nodule of matrix, with cast of brain, of *Nythosaurus larvatus*.

PLATE XXXV.

Fig. 1. Mass of matrix, with imbedded vertebræ, ribs, scapula, humerus, and antibrachium of *Dicynodon tigriceps*; half nat. size.
2. Section of the body of a vertebra of the same.
3. Section of the body of a vertebra of *Dicynodon rectidens*.

PLATE XXXVI.

Dicynodon tigriceps.

Fig. 1. Under or front (hæmal) view of pelvis; three eighths nat. size.
2. Distal articular ends of first and second sacral ribs; three eighths nat. size.
3. Upper or back (neural) view of first and second sacral vertebræ; three eighths nat. size.
4. Distal articular surface of second sacral rib; one fifth nat. size.

PLATE XXXVII.

Dicynodon tigriceps.

Fig. 1. Left-side view of pelvis; three eighths nat. size.
2. Under (hæmal) view of pubis and ischium (in this view the lower end or outlet of the pelvis is drawn uppermost); three eighths nat. size.

PLATE XXXVIII.

Dicynodon pardiceps.

Fig. 1. Left-side view of skull, wanting the lower jaw; *c*, section of canine.
2. Back view of the same; half nat. size.

PLATE XXXIX.

Dicynodon pardiceps.

Fig. 1. Upper view of skull; half nat. size.
2. Under view of the same; half nat. size.

PLATE XL.

Dicynodon rectidens.

Fig. 1. Left-side view of part of mutilated skull.
2. Under view of the same.

PLATE XXV

PLATE XLI.

Dicynodon pardiceps.

Fig. 1. Front (thenal) view of left humerus.
2. Upper (proximal) articular end of the same.

PLATE XLII.

Dicynodon pardiceps.

Fig. 1. Back (anconal) view of left humerus.
2. Inner (ulnar) side view of the same.

PLATE XLIII.

Dicynodon feliceps.

Fig. 1. Left-side view of skull.
2. Upper view of the same.
3. Back view of the same.
4. Under view of the same.
5. Front view of mandible, with the ends of the upper canines.
6. Section of fractured right upper canine and its socket.

PLATE XLIV.

Fig. 1. Upper view of fore part of skull of *Dicynodon testudiceps.*
2. Under view of the same, with sections of canines.
3. Left-side view of the same.
4. Left-side view of fore part of skull, wanting the lower jaw, of *Oudenodon strigiceps*.*

PLATE XLV.

Ptychognathus declivis.

Fig. 1. Left-side view of skull, wanting the lower jaw.
2. Upper view of the same.
3. Outline of fore part of upper jaw, with sections of the canines.

PLATE XLVI.

Fig. 1. Back view of the skull of *Ptychognathus declivis.*
2. Back view of the skull of *Ptychognathus latirostris.*

PLATE XLVII.

Ptychognathus latirostris.

Fig. 1. Upper view of the skull.
2. "Symphysis mandibulæ" and corresponding part of upper jaw, with the broken canines.
3. Under view of mandible.

* This is wrongly marked *Ptychognathus* on the Plate.

PLATE XLVIII.

Fig. 1. Right-side view of skull of *Ptychognathus boopis*.
2. Left-side view of skull of *Ptychognathus latirostris*.

PLATE XLIX.

Fig. 1. Under view of the skull, wanting the lower jaw, of *Ptychognathus verticalis*.
2. Back view of the same.
3. Upper view of the skull of *Ptychognathus boopis*.

PLATE L.

Ptychognathus Alfredi.

Fig. 1. Right-side view of the skull.
2. Upper view of the same.
3. Back view of the same.
4. Under view of the same.
5. Front view of the same.
6. Section of broken left canine and socket (p, p).

PLATE LI.

Ptychognathus depressus.

Fig. 1. Right-side view of the skull.
2. Upper view of the same.
3. Front view of the same, in outline; two thirds nat. size.

PLATE LII.

Figs. 1 & 2. Plaster cast of a mould in matrix left by part of the skeleton and skin of a small Dicynodont; it includes vertebræ and ribs of the fore part of the trunk (fig. 1) and the bones of the fore limb (fig. 2).
Fig. 3. Mould of the forearm and of the bones of the fore paw impressed upon the matrix.

PLATE LIII.

Fig. 1. Upper (neural) view of vertebræ and sacrum of *Ptychognathus pusillus*.
2. Left-side view of a dorsal vertebra of *Dicynodon pardiceps*.
3. Front view of the same.
4. Vertical longitudinal section of centrum of the same, in outline.
5. Vertical longitudinal section of centrum of dorsal vertebra of *Pareiasaurus bombidens*.

PLATE LIV.

Oudenodon magnus.

Left-side view of skull, wanting the lower jaw; c', section of caniniform process of maxillary.

PLATE LV.

Oudenodon magnus.

Upper view of mutilated skull; half nat. size.

PLATE LVI.

Fig. 1. Under view of mutilated skull of *Oudenodon magnus*; half nat. size.
2. Under view of mutilated skull of *Oudenodon Bainii*; nat. size.

PLATE LVII.

Oudenodon magnus.

Fig. 1. Left-side view of the dentary element of lower jaw.
2. Alveolar border of symphysis of the same.
3. Section of the same.

PLATE LVIII.

Oudenodon brevirostris.

Fig. 1. Upper view of skull; half nat. size.
2. Under view of the same, without lower jaw; half nat. size.

PLATE LIX.

Oudenodon brevirostris.

Fig. 1. Left-side view of dentary element of lower jaw.
2. Under view of symphysis of the same.
3. Alveolar grooved edentulous border of the same.

PLATE LX.

Oudenodon Bainii.

Fig. 1. Left-side view of skull, wanting the lower jaw.
2. Upper view of the same.
3. Front view of the same.

PLATE LXI.

Oudenodon prognathus.

Fig. 1. Right-side view of skull, wanting the hind end.
2. Under view of the same.
3. Upper view of the same.
4. Front view of the same.

Fig. 1.

PL. I.

PLATE LXII.

Oudenodon Greyi.

Fig. 1. Right-side view of the skull.
2. Oblique upper view of the same.

PLATE LXIII.

Fig. 1. Upper view of mutilated skull of *Theriognathus microps*; half nat. size.
2. Under view of the same; half nat. size.
3. Left-side view of the same; half nat. size.
4. Upper view of the skull of *Oudenodon megalops*.
5. Under view of the same, without the lower jaw.

PLATE LXIV.

Fig. 1. Upper view of mutilated skull of *Kistecephalus leptorhinus*.
2. Left-side view of the same.
3. Front view of the same.
4. Upper view of mutilated skull of *Kistecephalus microrhinus*.
5. Left-side view of the same.
6. Back view of the same.
7. Front view of the same, wanting the lower jaw.
8. Upper view of mutilated skull of *Kistecephalus chelydroides*.
9. Back view of the same.
10. Left-side view of mutilated skull of *Kistecephalus planiceps*.
11. Right-side view of the same.
12. Upper view of the same.
13. Back view of the same.

PLATE LXV.

Fig. 1. Upper view of a mutilated skull of *Kistecephalus arctatus*.
2. Upper view of a less-mutilated skull of the same.
3. Left-side view of the same.
4. Right-side view of the same.
5. Front view of the same, without the lower jaw.
6. Back view of the same.
7. Left-side view of the skull of *Kistecephalus bathygnathus*.
8. Under view of the skull and hyoid apparatus of *Oudenodon Greyi*.

PLATE LXVI.

Endothiodon bathystoma.

Left-side view of fore part of the skull.

PLATE LV.

PLATE LXVII.

Endothiodon bathystoma.

Fig. 1. Palatal surface of fore part of the skull, and teeth of the same.
2. Upper surface of fore part of the lower jaw, and teeth of the same.
3. Front view of symphysis mandibulæ.
4. Transverse section of palatal teeth.
5. Vertical transverse section of mandibular ramus and teeth.
6. Horizontal section of caniniform process of upper jaw (at *c' c'*, Plate LXVI.).

PLATE LXVIII.

Lycosaurus curvimola.

Fig. 1. Right-side view of skull, with mutilated occiput.
2. Left-side view of fore part of the same.
3. Front view of upper jaw.
4. Symphysis of under jaw, with corresponding part of upper jaw and teeth in outline.
5. Third right molar, magnified.

PLATE LXIX.

Fig. 1. Left-side view of the skull of *Dicynodon dubius*.
2. Under view of fore part of the same.
3. Left-side view of crushed skull of *Dicynodon recurvidens*.
4. Upper view of the same.
5. Outer-side view of parts of the mutilated scapular arch of a small Dicynodont.
6. Inner-side view of the same.
7. Part of occipital surface of *Kistecephalus microrhinus*, showing:—2, exoccipitals; 3, supra-occipital; 4, paroccipital.
8. Part of scapular arch of the same.
9. Outer-side view of left scapula of the same.
10. Section of two dorsal vertebræ of the same.

PLATE LXX.

Fig. 1. Inner-side view of the right scapula, with part of the precoracoid, in outline, of *Dicynodon leoniceps*.
2. Vertical longitudinal section of a dorsal vertebra, with parts of contiguous vertebræ in outline, of *Anthodon serrarius*.
3. Parts and impressions of a mutilated skull, anterior vertebræ, and episternum of *Saurosternon Bainii*, Huxley; *c'*, portion of maxilla and base of teeth, magnified.
3*. Portion of mandibula and teeth, magnified.
4. Dorsal view of parts and impressions of a skeleton, minus tail, of *Saurosternon Griesbachii*, Ow. (This specimen is in the Imperial Museum at Vienna, from which the drawing was made by the accomplished geologist and artist after whom it is named, and by whom it was obtained at the Cape of Good Hope. I am under much obligation to Mr. C. L. Griesbach, F.G.S., for the pains, intelligence, and skill which he has devoted to the Illustrations of the present Catalogue.)

Fig. 2.

Fig. 1.

C.L.Griesbach.

TAPINOCEPHALUS ATHERSTONII.

Mintern Bros. imp.

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Fig. 3.

Fig. 2.

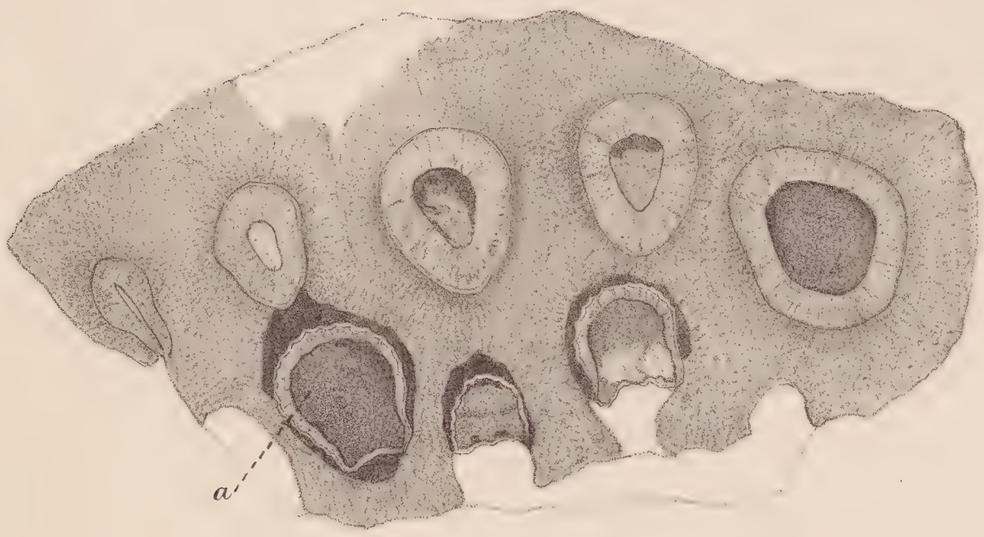

Fig. 1.

Fig. 4.

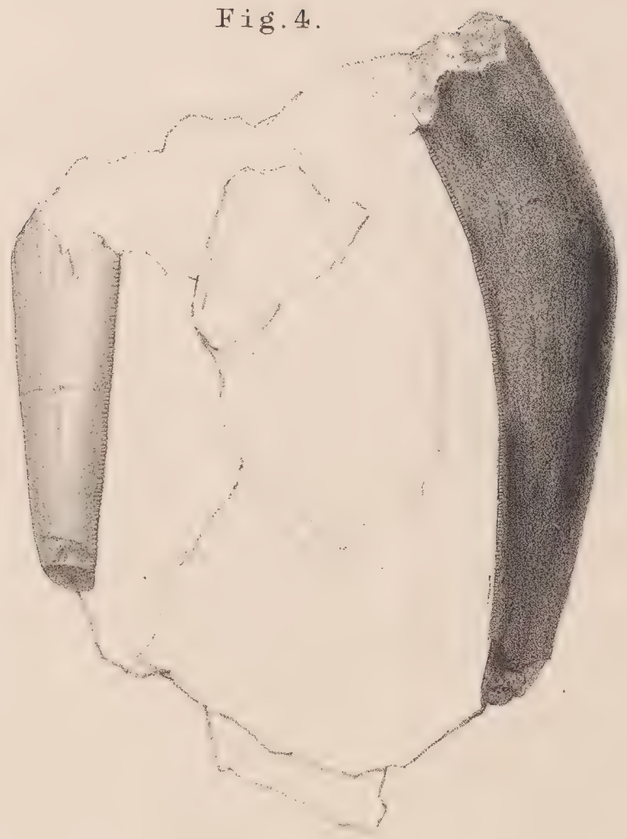

Fig. 5.

Fig. 6.

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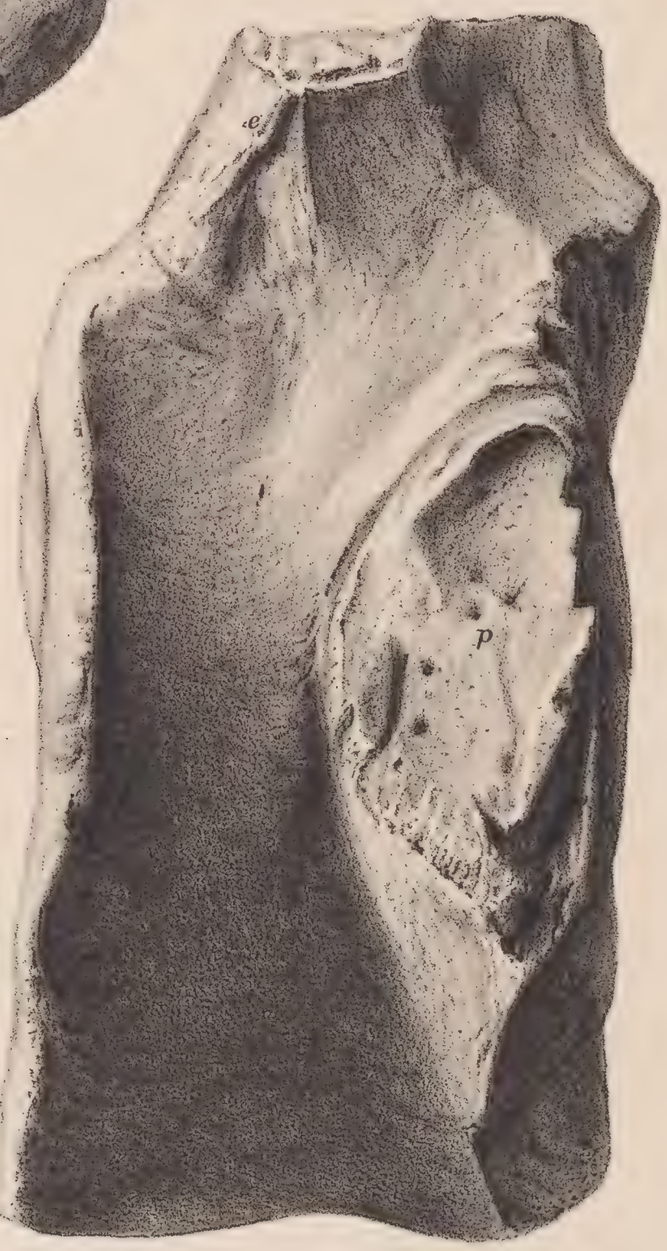
Mintern Bros. imp.

Figs. 1—3. Tapinocephalus Atherstonii; Figs. 4—6. Gynodrakon major.

Fig. 1.

Fig. 2.



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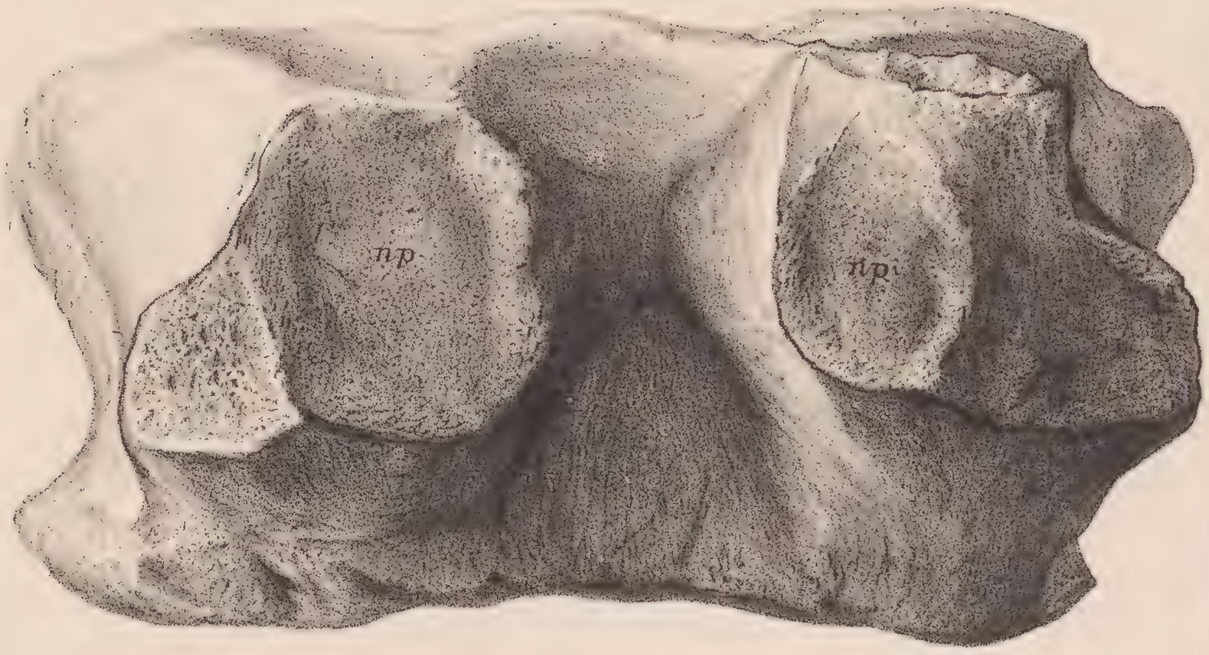

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Tapinocephalus Atherstonii.

Mintern Bro. .imp.

Fig. 1.

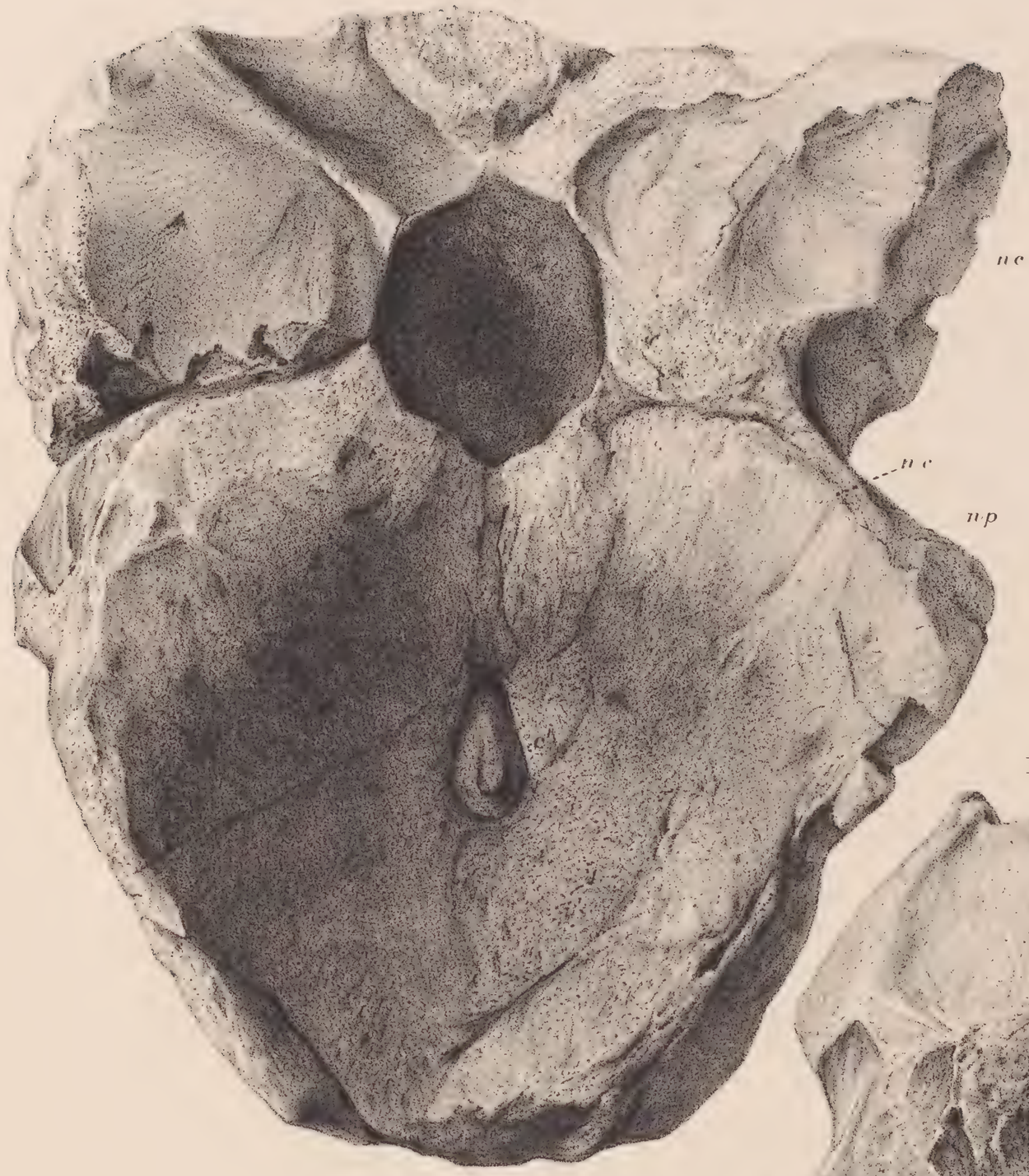

Fig. 2.

Fig. 3.

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Mintern Bros. imp.

Tapinocephalus Atherstonii.

Fig. 1.

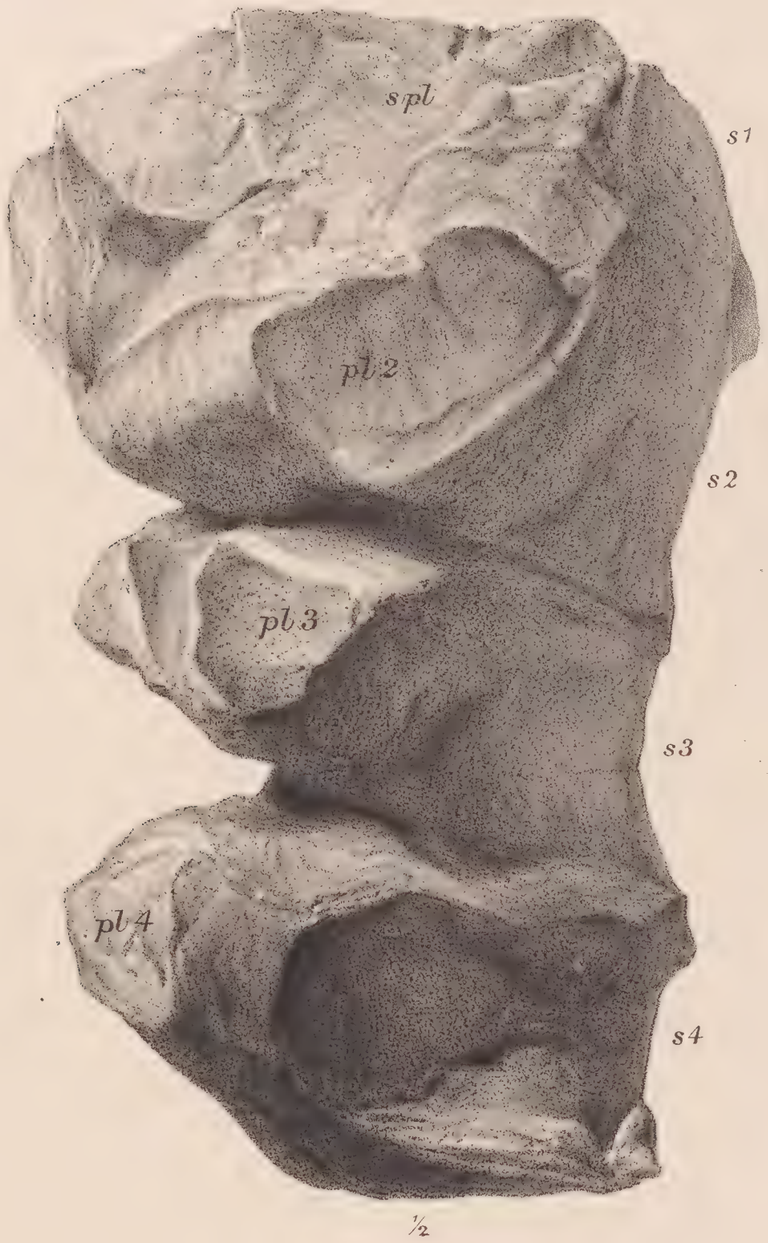

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Fig. 2.

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Fig. 3.

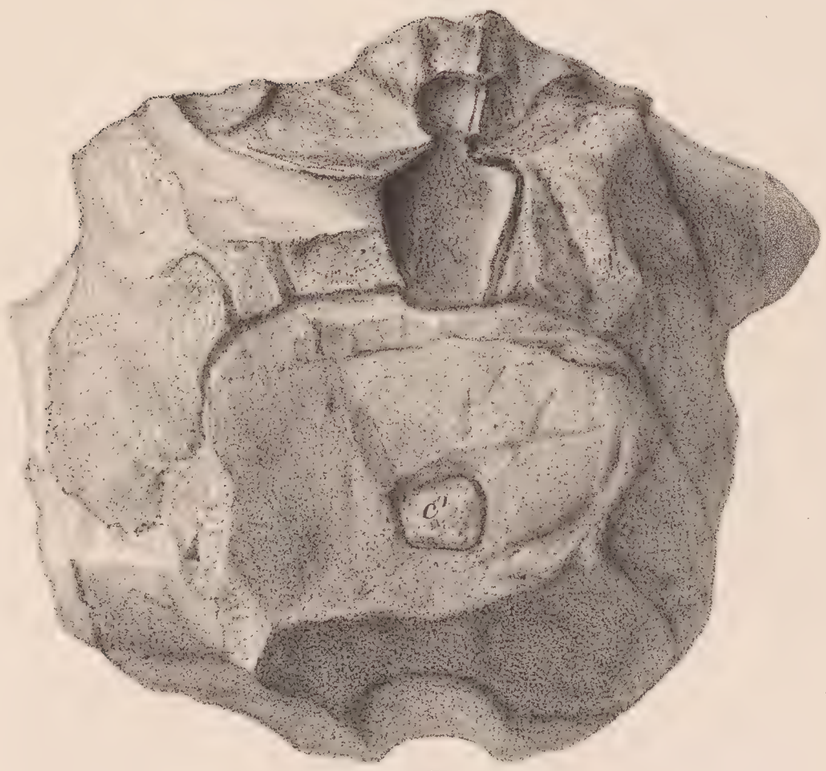

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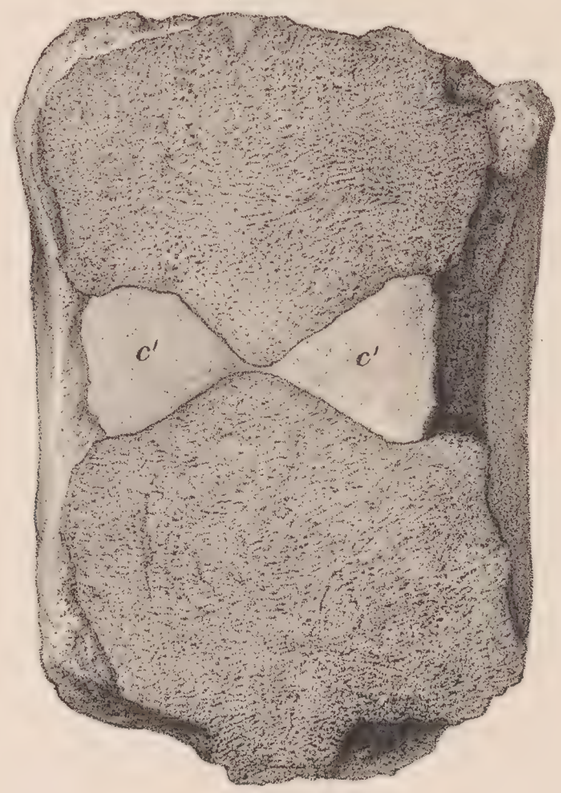
Fig. 4.



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Tapinocephalus Atherstonii.

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C.I. Griesbach.

Parvisaurus serridens. 3

Mintern Bros. imp.

C.L. Griesbach.

$\frac{2}{3}$

Mintern Bros. imp.

Parciasaurus serridens.

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Fig. 2.

Fig. 3.

Pareiasaurus serridens.

C.L. Griesbach.

Mintern Bros. imp.

Pl. VII.

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Fig. 1.

Fig. 2.

Fig. 3.

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Lithtern Kgl. Hofl. Amp.

Figs. 1–2. Pareiasaurus serridens. Fig. 3, Pareiasaurus bombidens.

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C L. Griesbach

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Pareiasaurus bombidens.

Fig. 1.

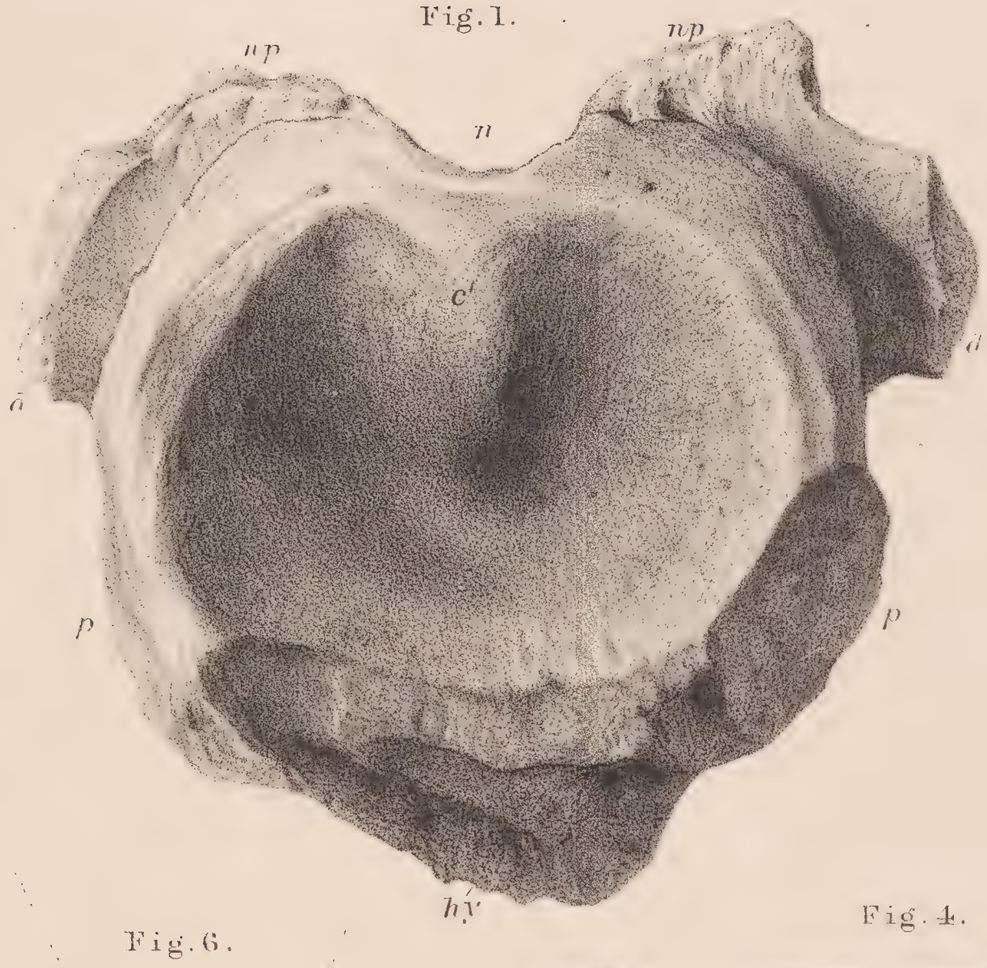


Fig. 3.

Fig. 6.

Fig. 4.

Fig. 2.

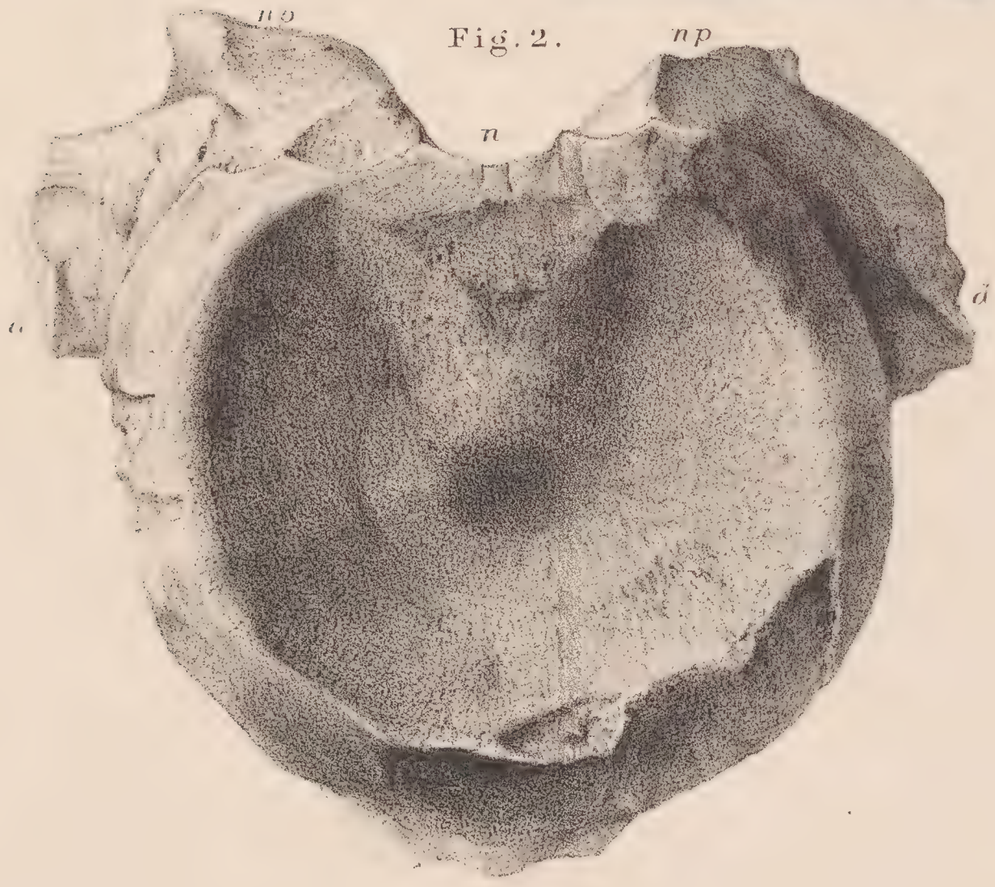
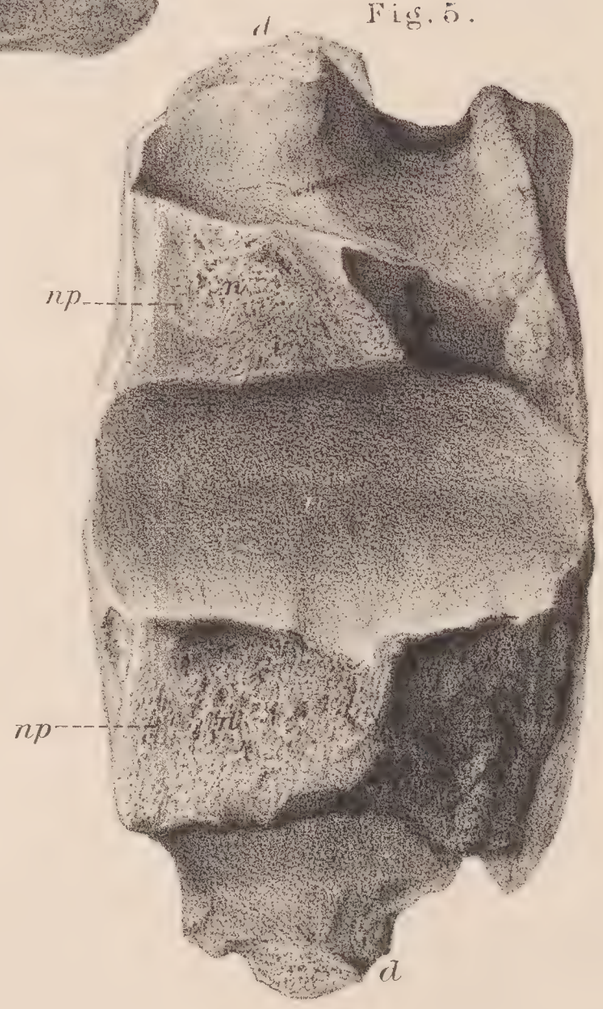


Fig. 5.



C.L.Griesbach.

Mintern Bros. imp.

Parciasaurus bombidens.

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Fig. 1.

Fig. 3.

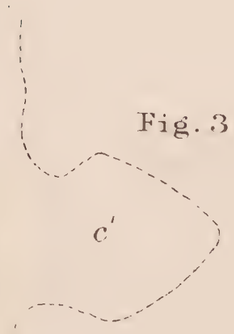

Fig. 2.

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Pl. XI.

Parciasaurus.

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Pl. XII.

Fig. 3.

Fig. 5.

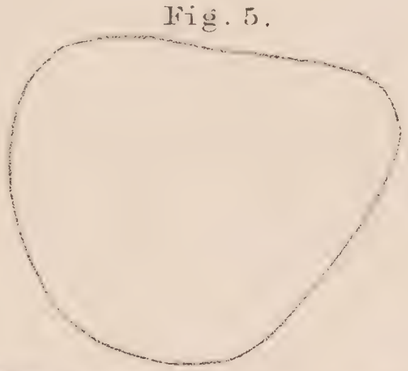

Fig. 1.

Fig. 4.

Fig. 2.

C.L. Griesbach

Parciasaurus bombidens: ⅓ nat. size

Mintern Bros. imp.

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PA U S A

Fig. 1.

Fig. 2.

Fig. 3.

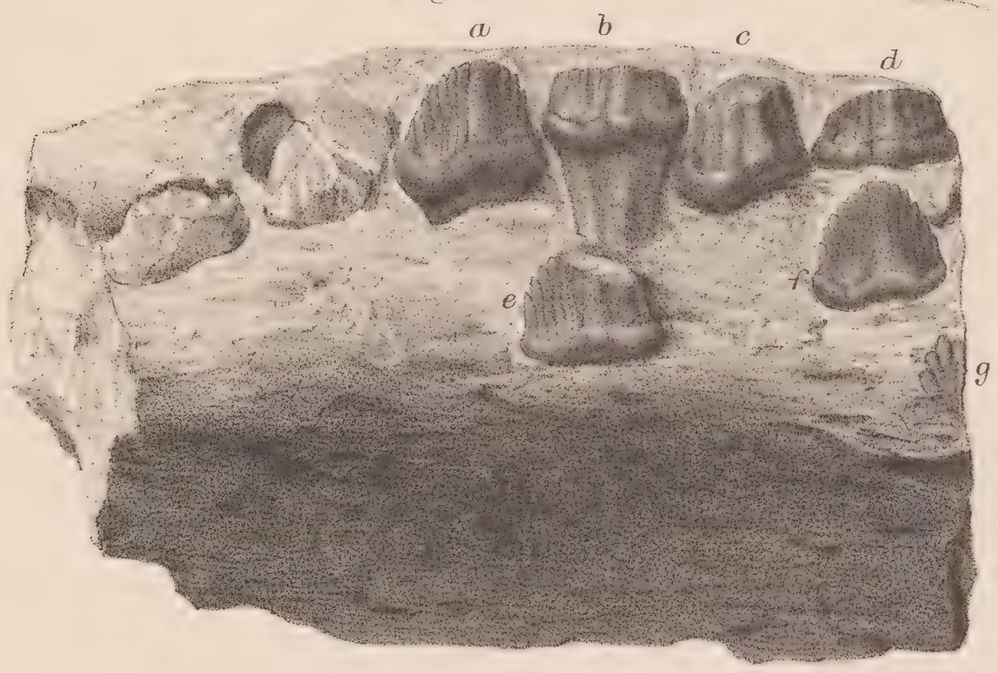

Fig. 4.

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Anthodon serrarias.

Mintern Bros. imp.

Fig. 1.

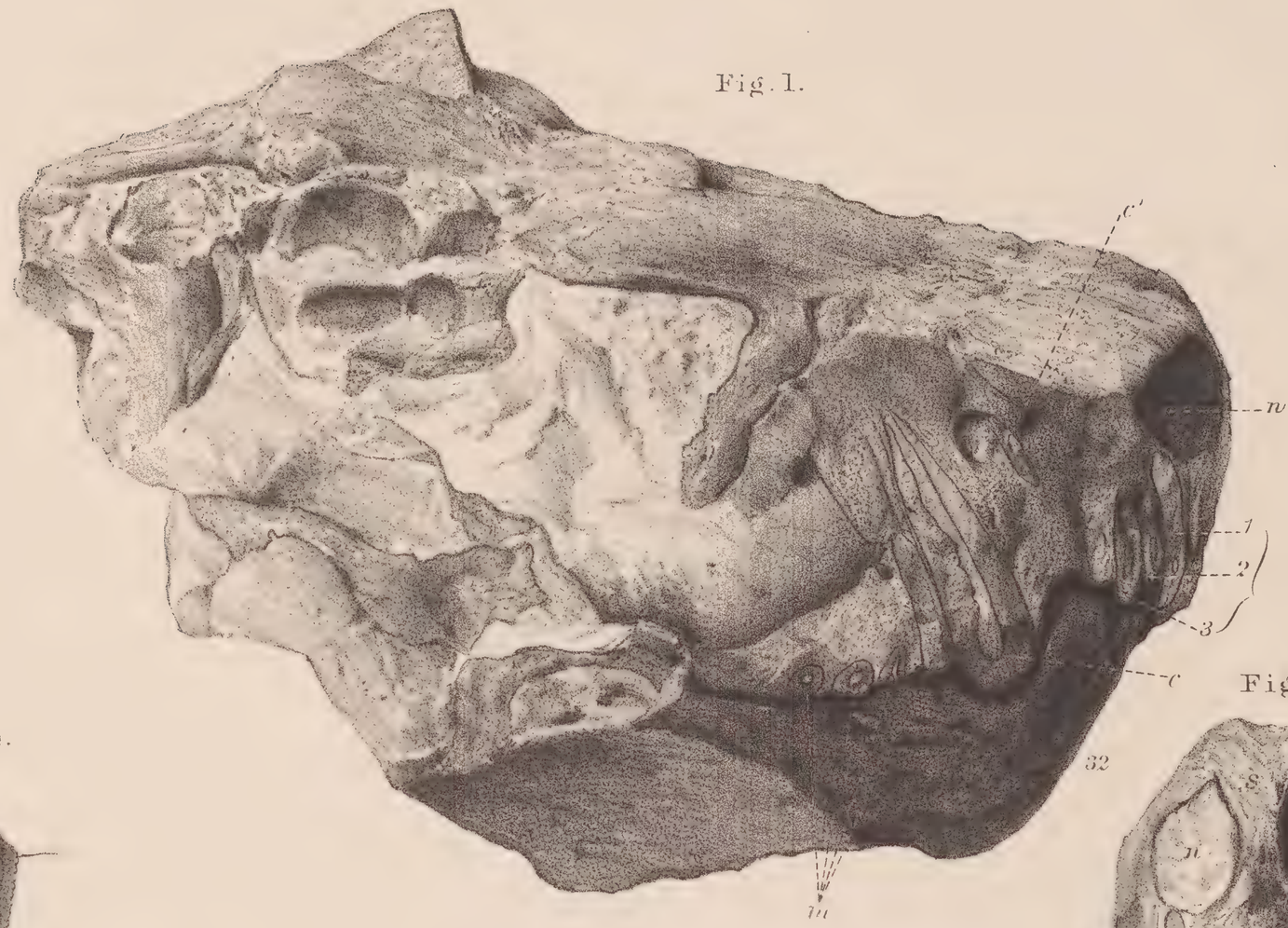
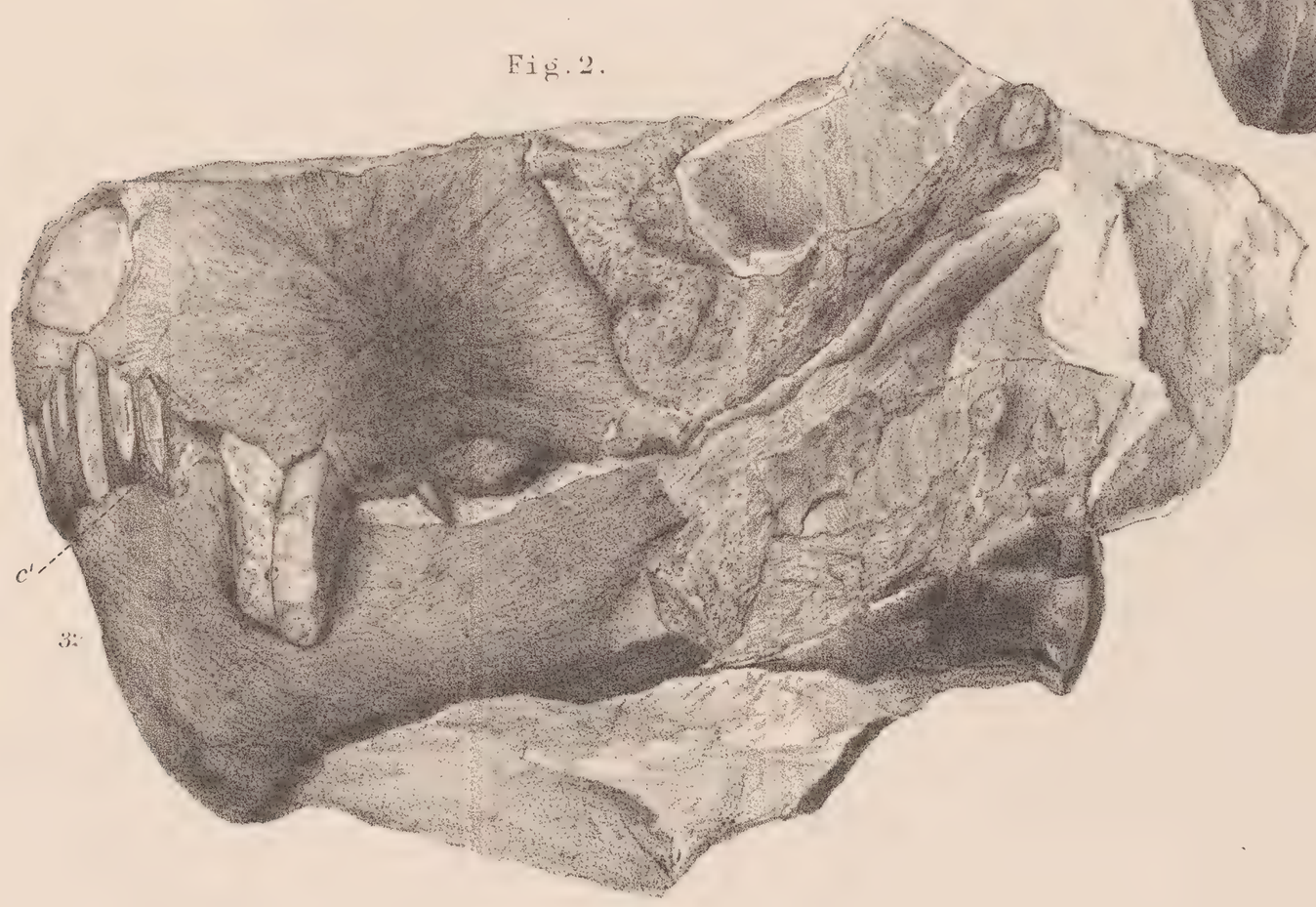


Fig. 4.

Fig. 5

Fig. 3.

Fig. 2.



C. L. Grotsbach.

Mintern. Bros. imp.

Lycosaurus pardalis.

Fig. 1.

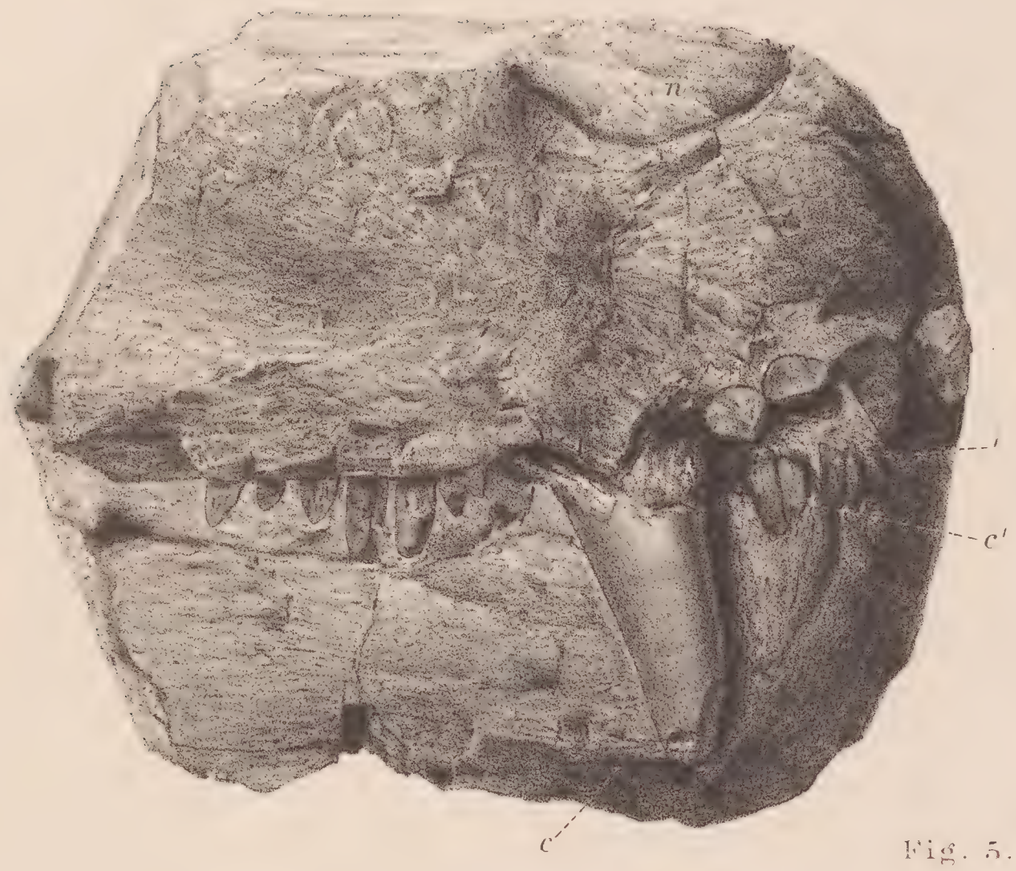


Fig. 3.

Fig. 5.

Fig. 2.

Fig. 4.

C. H. Griesbach.

Mintern Bros. imp.

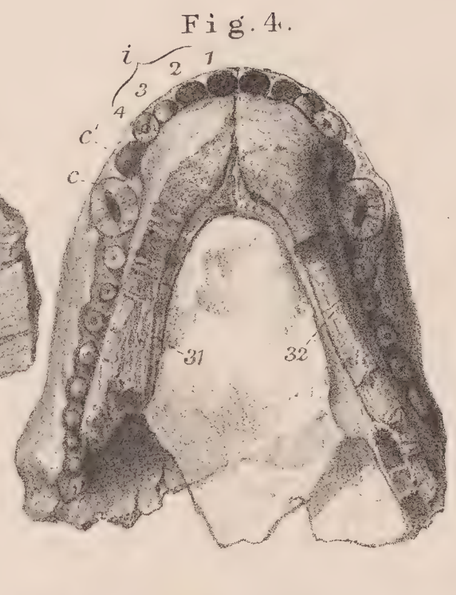
Lycosaurus tigrinus.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



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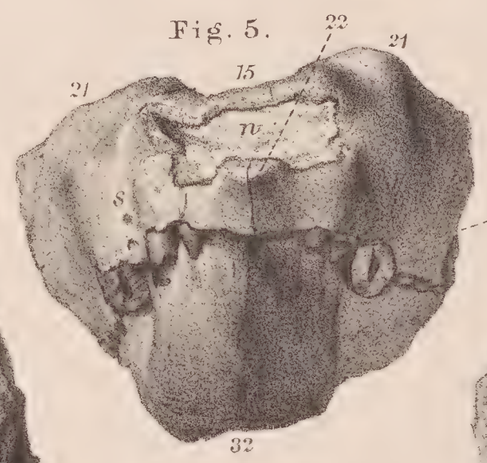

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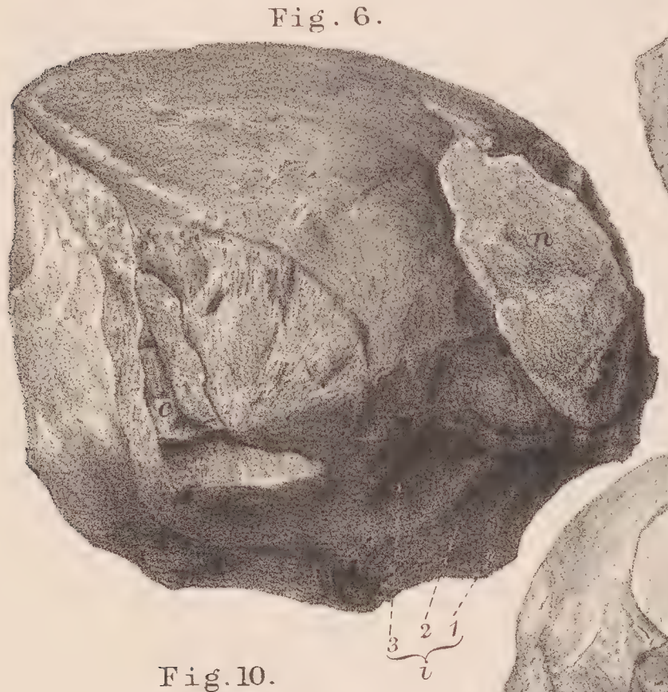
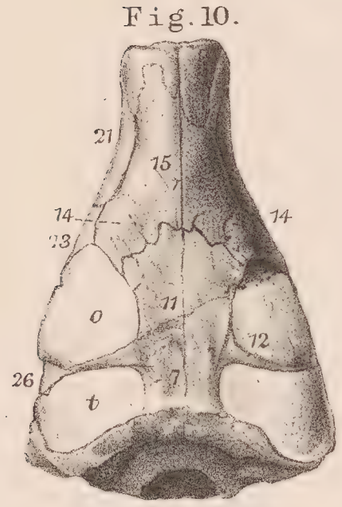


Fig. 7.

Fig. 8.

Fig. 10.



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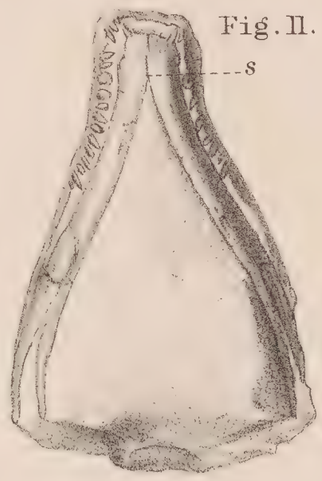

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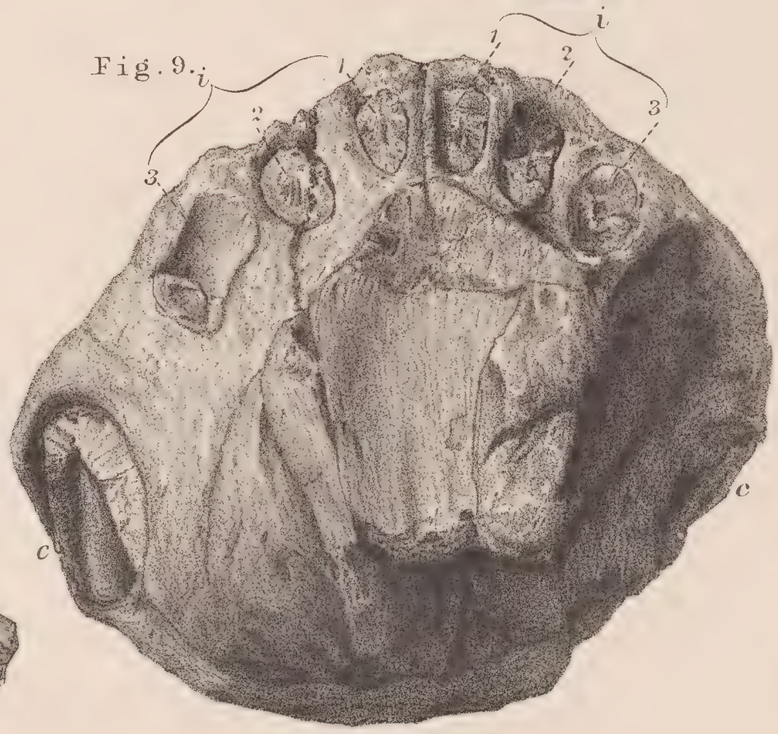
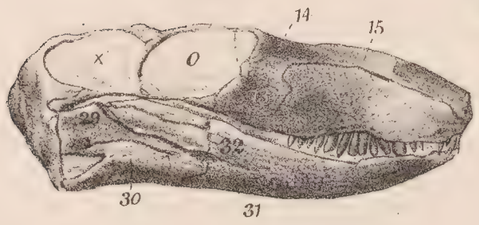


Fig. 12.

Fig. 13.

Fig. 14.



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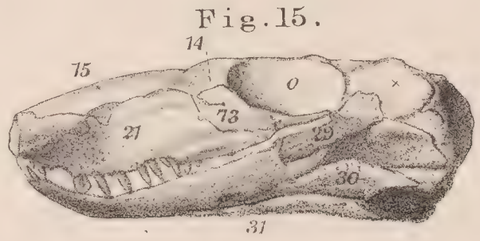

C.L. Griesbach.

Mintern Bros. imp.

1–5 Cynosuchus; 6–9 Tigrisuchus; 10–15 Scalposaurus.

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Fig. 1.

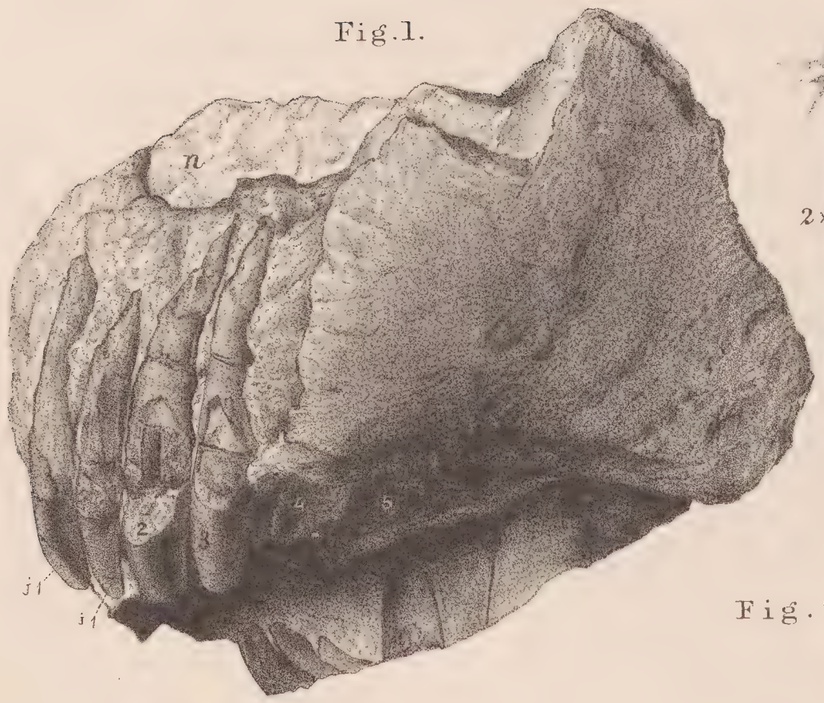
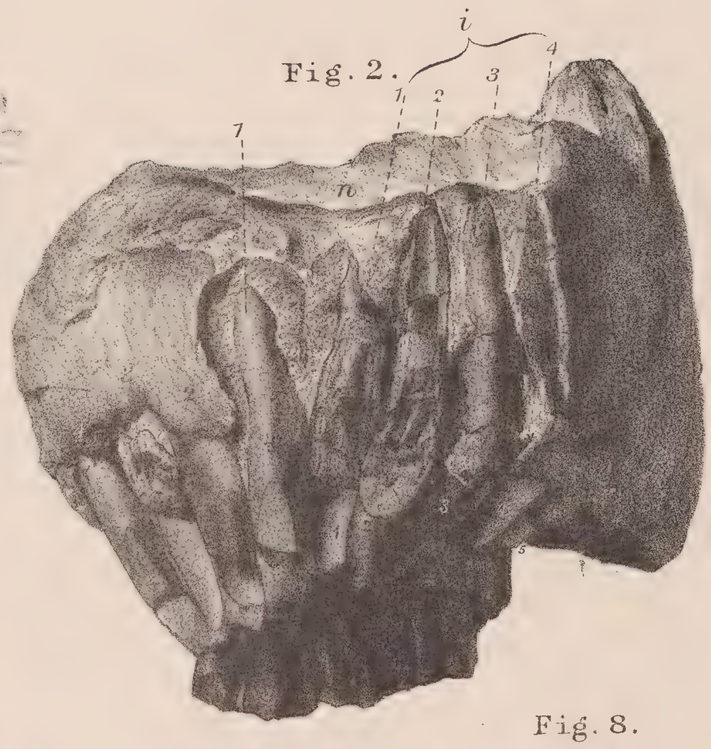


Fig. 6.

Fig. 7.

Fig. 2.



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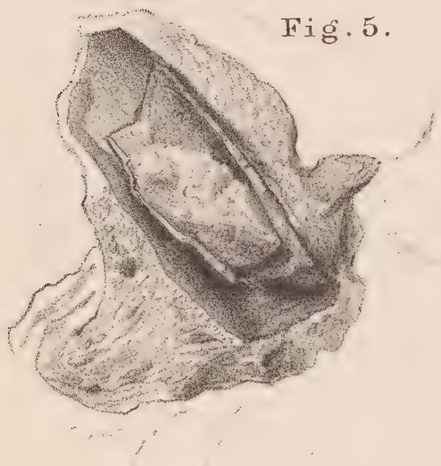

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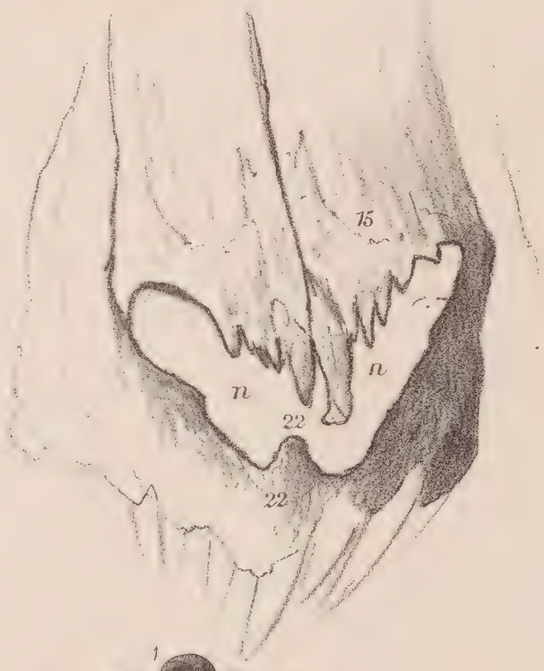

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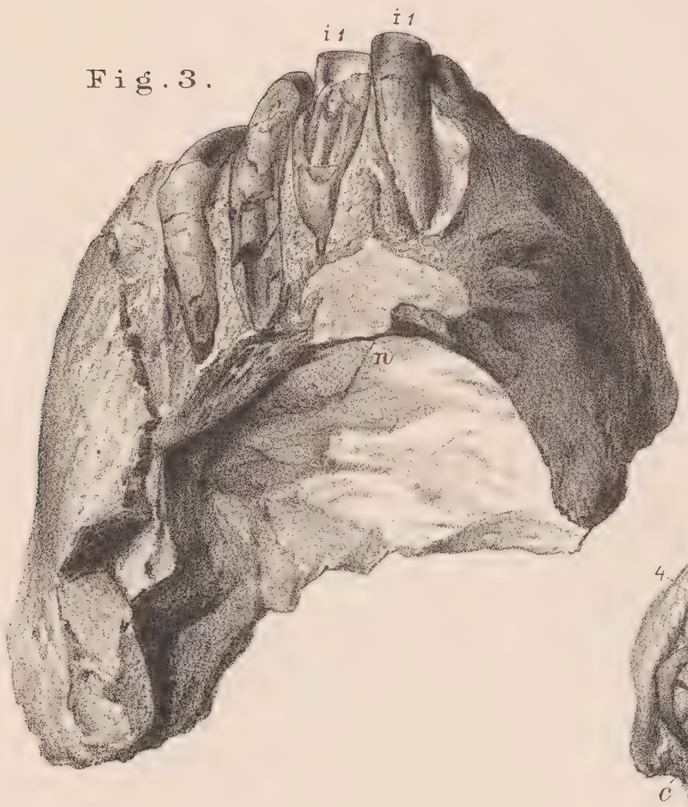

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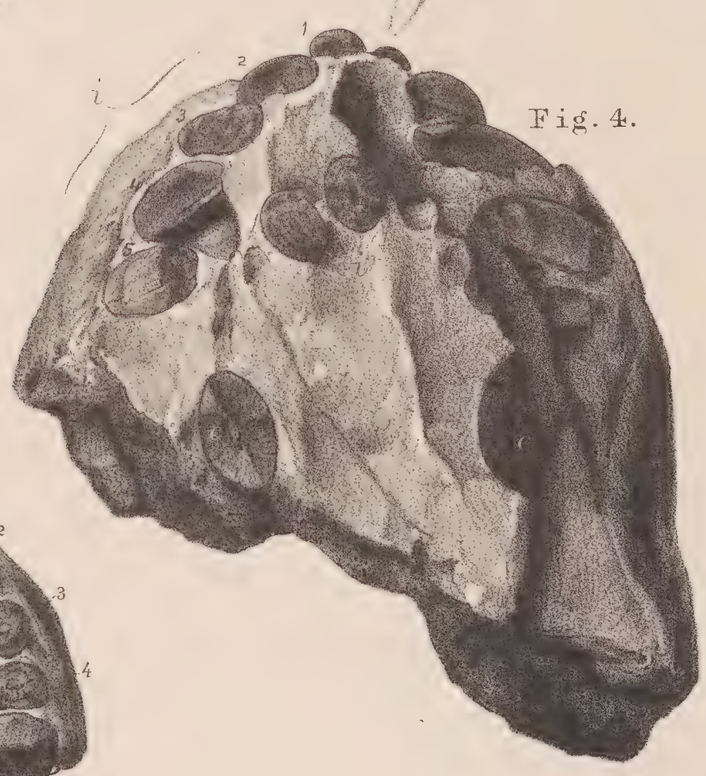


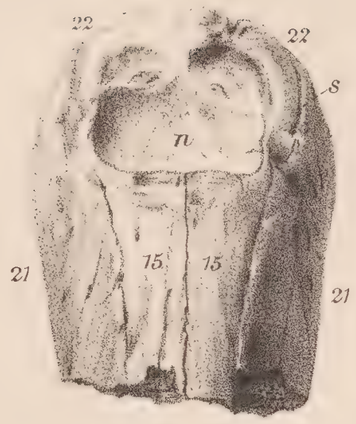
Fig. 10.

C. L. Griesbach.

Mintern Bros. imp.

Gynodrakon serridens.

Fig. 1.



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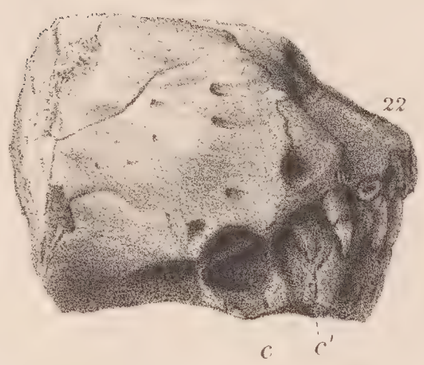

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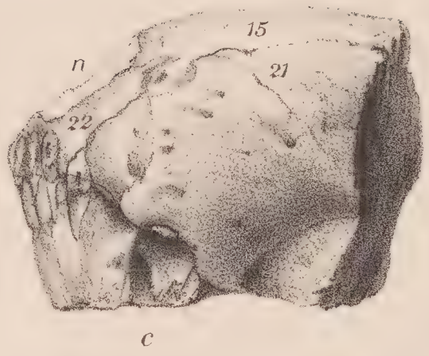

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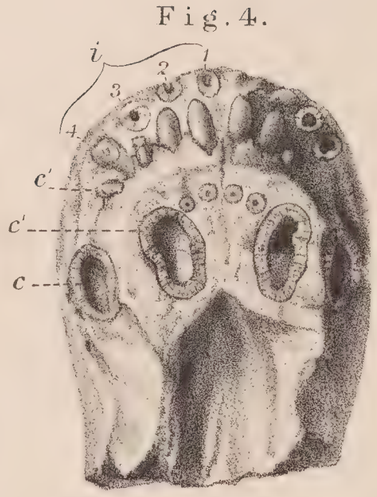

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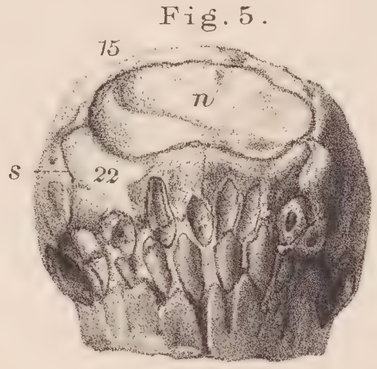

Fig. 8.

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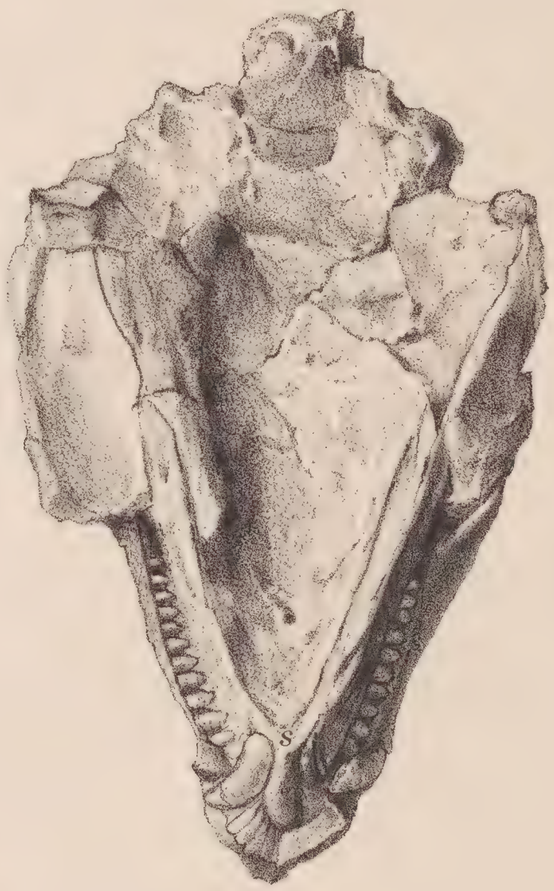

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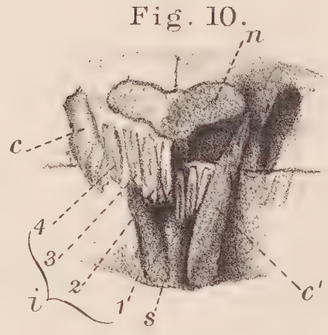

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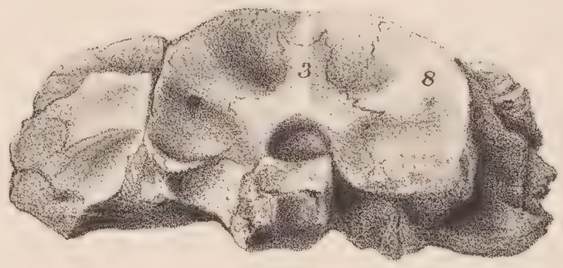
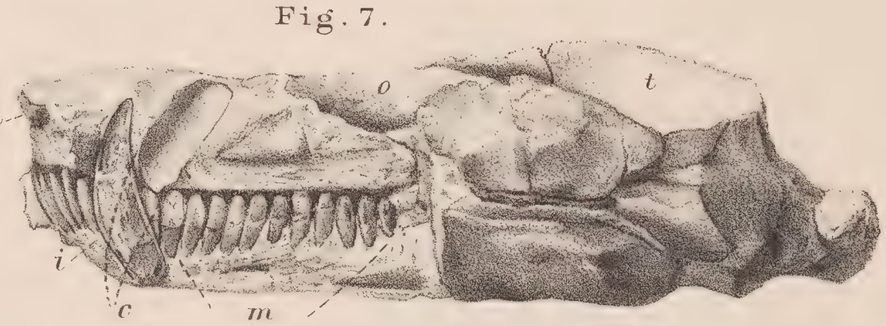


Fig. 6.

Fig. 7.

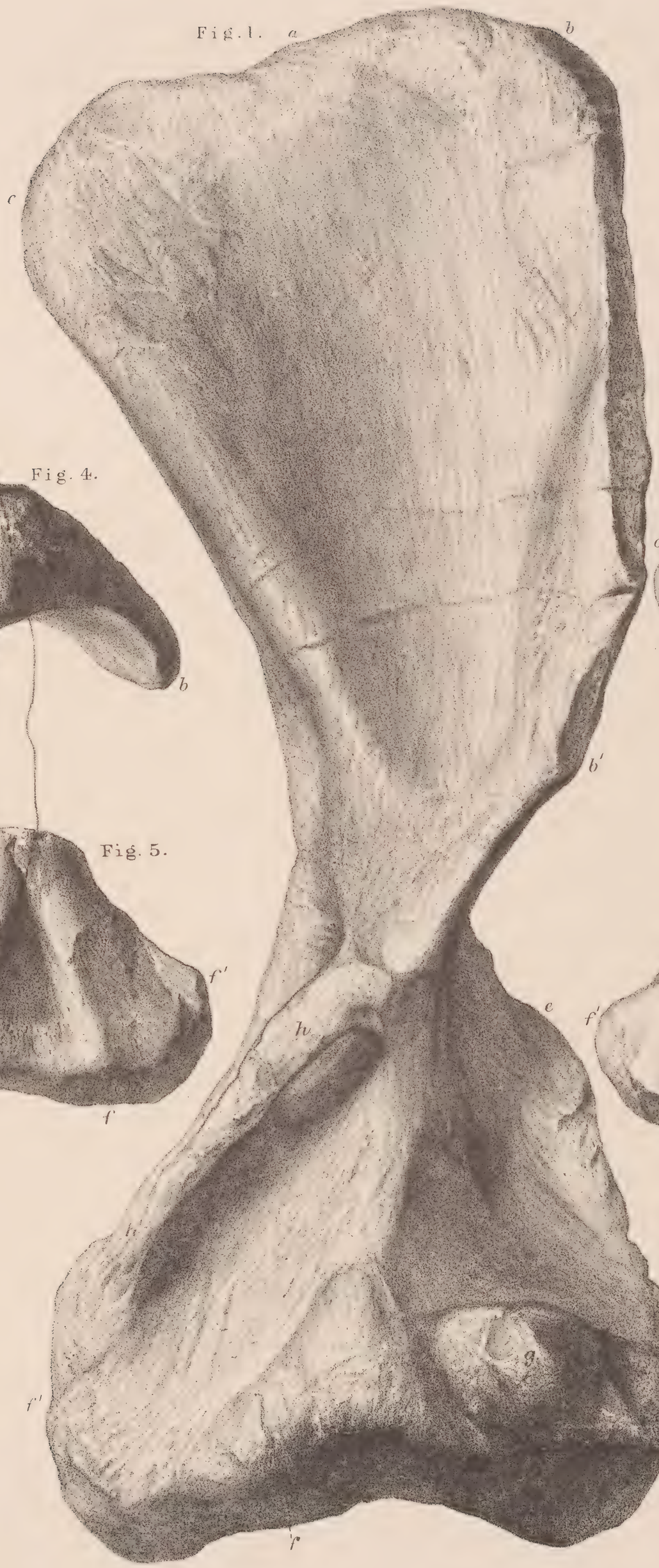


C.L. Griesbach.

Mintern Bros. imp.

Figs. 1–5 Cynochampsa; 6–11 Galesaurus.

Fig. 1.



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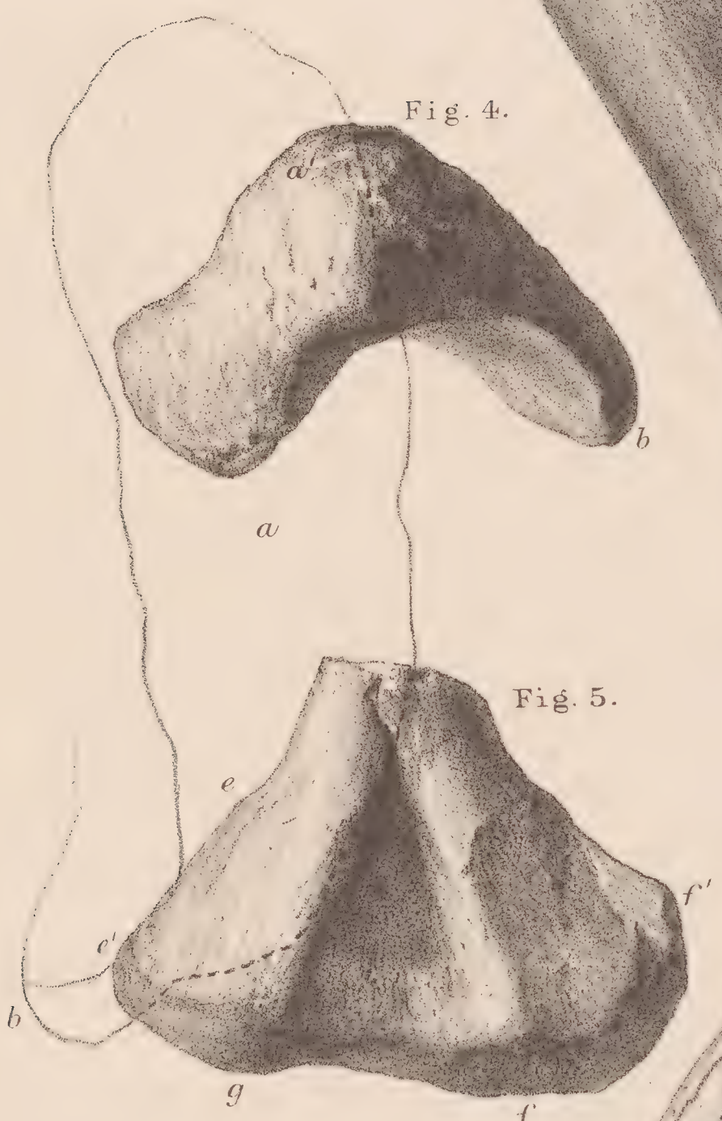

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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Figs. 1 & 2. Cynodraken major: Figs. 3–6. Cynochampsa laniarius.

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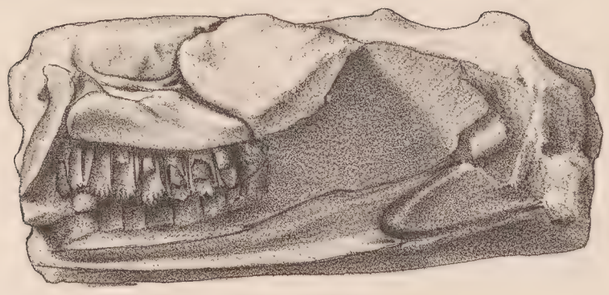
Fig. 2.

Fig. 1.



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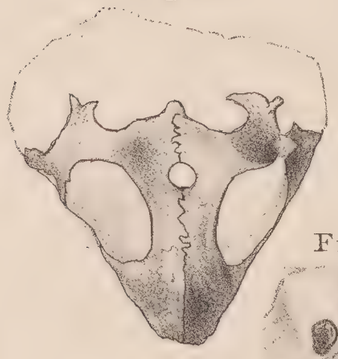


Fig. 11.

Fig. 3.

Fig. 9.

Fig. 12.

Fig. 10.

Fig. 4.

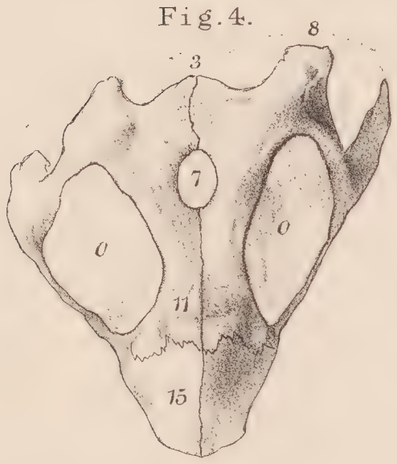


Fig. 5.

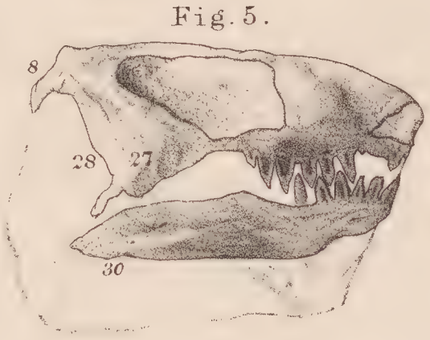
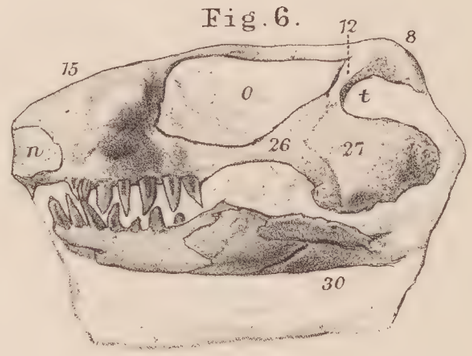


Fig. 7.

Fig. 6.



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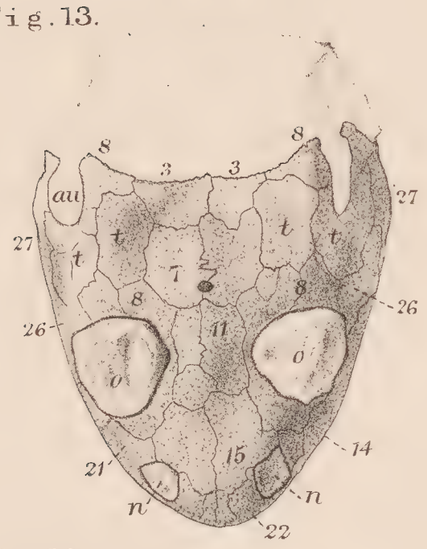

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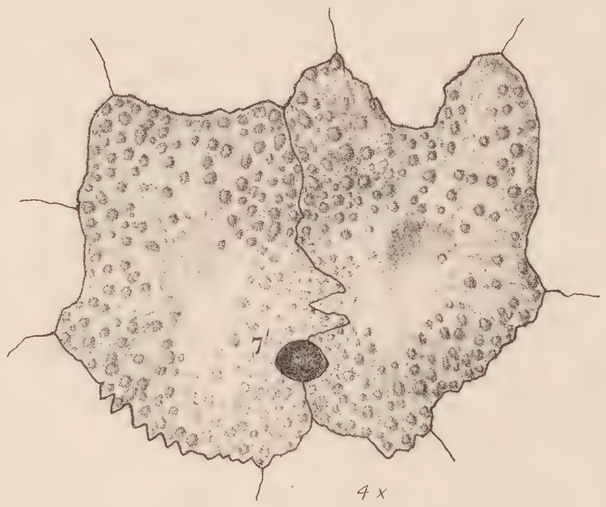

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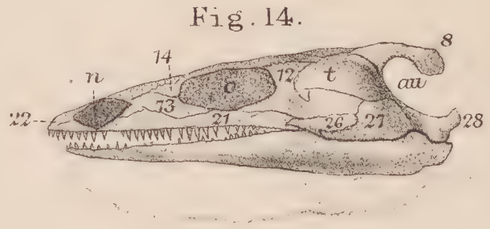

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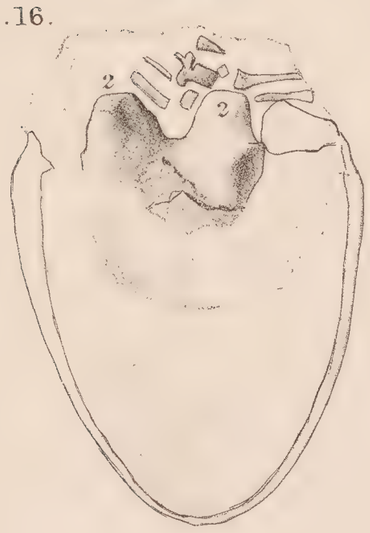

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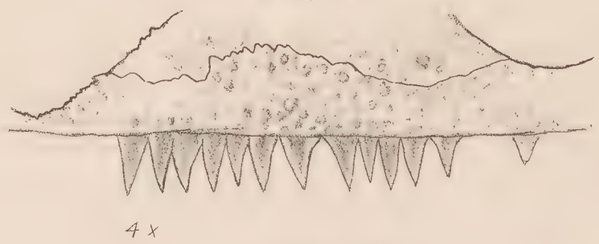

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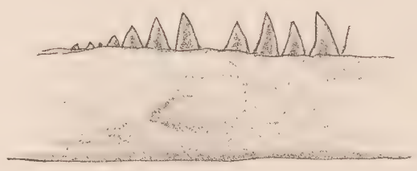

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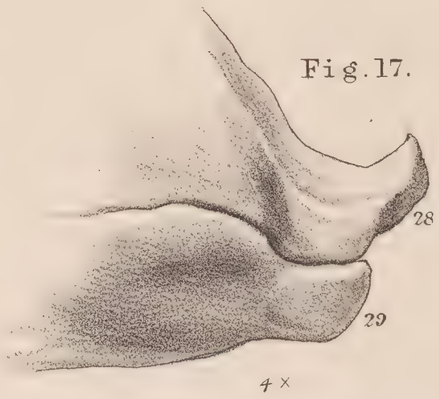

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Mintern Bros. imp.

Figs. 1–3. Nythosaurus: 4–7. Procolophon trigoniceps: 8–10. Procolophon minor: 13–20. Petrophryne granulata.

Fig. 1.

Fig. 3.

Fig. 2.

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Gorgonops torvus.

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C.L. Griesbach.

Griesbach Pinxit.

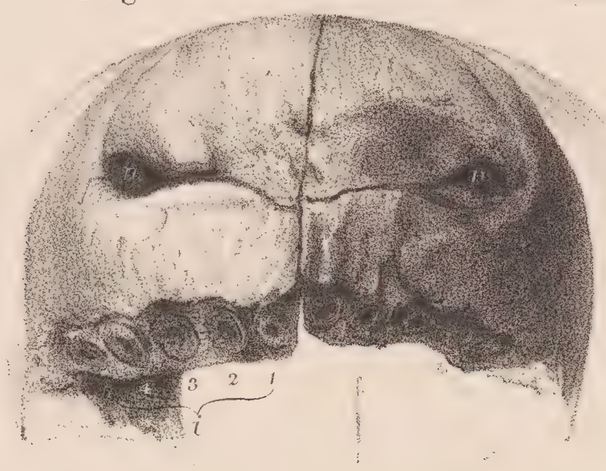
Minheim Lithog. Instp.

Pl. XXII.

Fig. 1.

Fig. 2.

Fig. 3.



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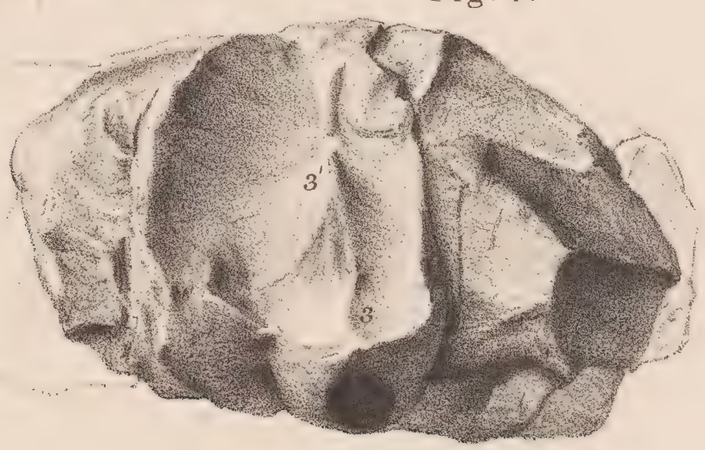


C.L. Griesbach.

Gorgonops torvus.

Mintern Bros. imp.

Fig. 2.

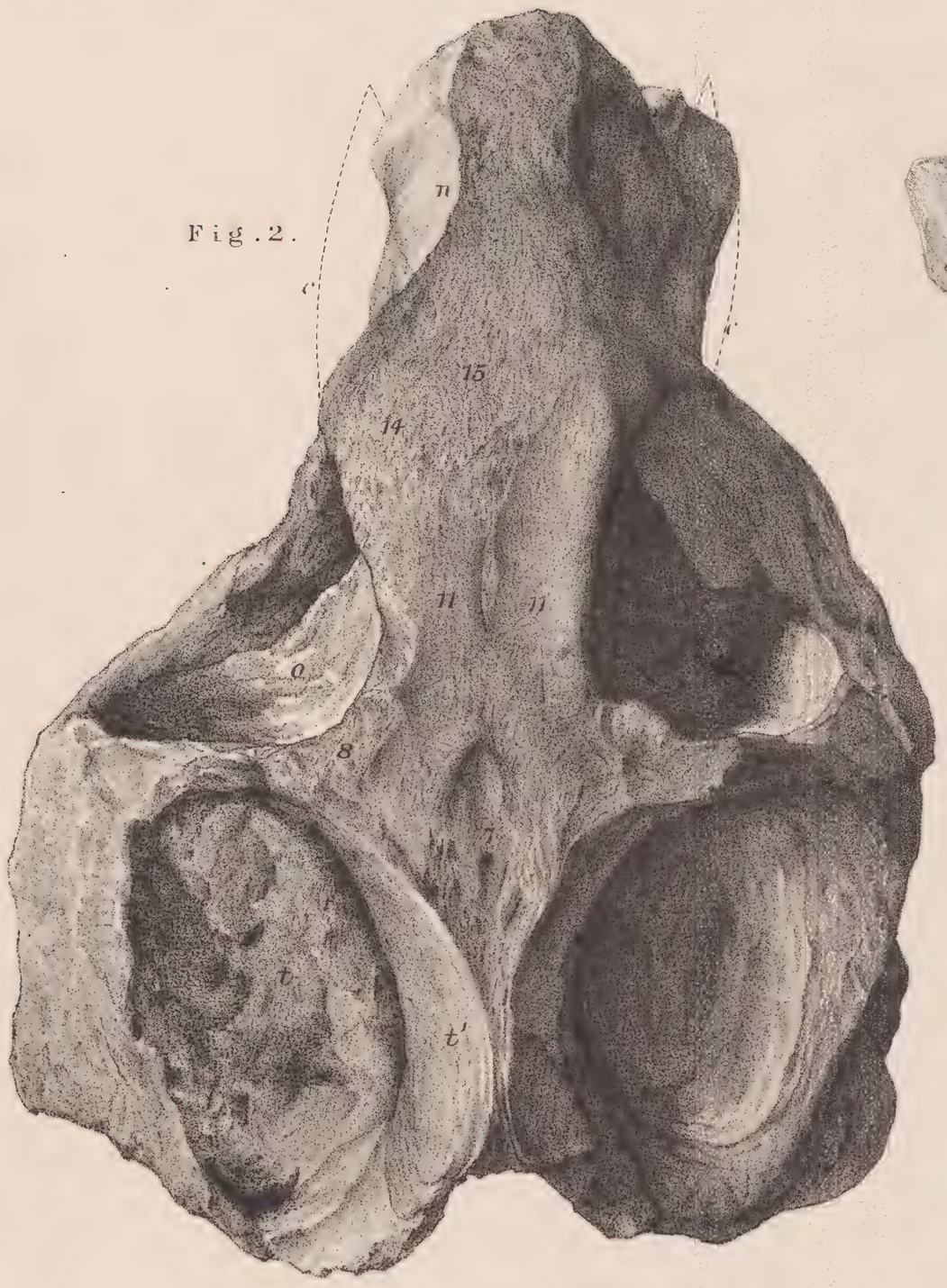
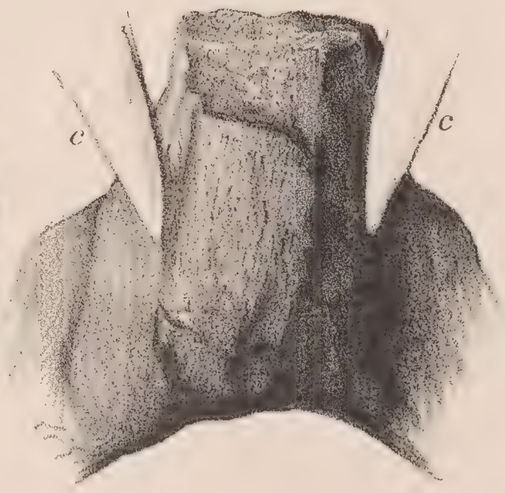


Fig. 3.

Fig. 4.

Fig. 1.

Fig. 5.



C. L. Griesbach

Meyer in Bronsvap

Dicynodon lacerticeps.

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C.L.Greisbach.

Dicynodon leoniceps.

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Dicynodon leoniceps.

Mintern Bros. imp.

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Fig. 1.

Fig. 2.

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Dicynodon leonicēps: Fig. 2 one third nat. size.

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Fig. 1

Fig. 2.

Mintern Bros. imp.

Dicynodon leoniceps.

Pl. XXVIII.

Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

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Figs. 1 – 2, Dicynodon leoniceps; 3 – 4, D. parvidens.

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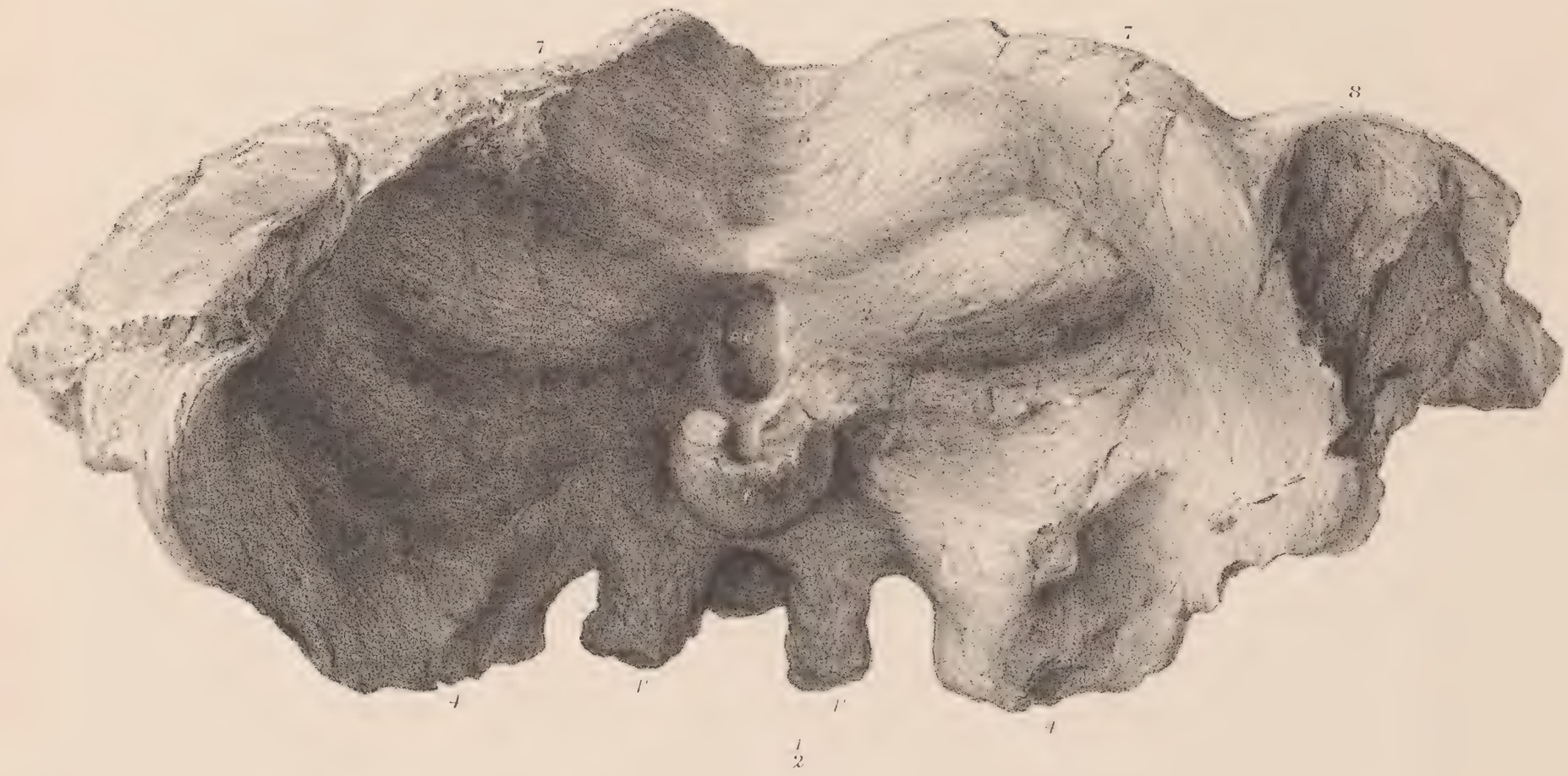
Dicynodon Bainii.

Mintern Bros. imp.

Fig. 1.

Fig. 2.



C.L. Griesbach.

Mintern Bros. imp.

Fig. 1 Dicynodon Bainii: 2 Dicynodon tigriceps.

Fig. 1.

Fig. 2.

C.L. Griesbach.

Mintern Bros. imp.

Fig. 1 Dicynodon tigriceps: 2 Dicynodon Bainii.

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Fig. 1.

Fig. 2.

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Mintern Bros. imp.

Fig. 1 Dicynodon tigriceps: 2 Dicynodon Bainii.

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C. L. Griesbach.

Dicynodon tigriceps.

Mintern Bros. imp.

C.L. Griesbach.

Fig. 1 Dicynodon tigriceps, ½ nat. size: 2 Nythosaurus larvatus.

Mintern Bros. imp

Fig. 2.

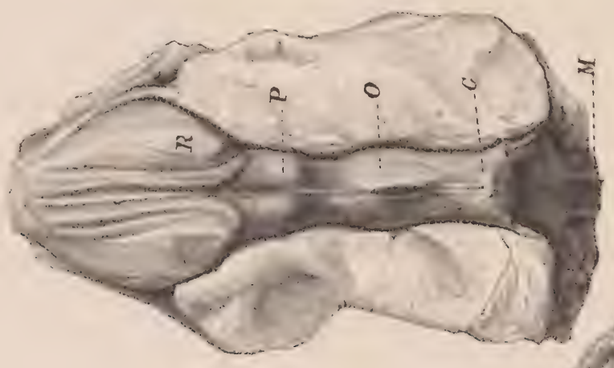

Fig. 1.

C.L. Griesbach

Mintern Bros. imp

Fig. 1 Dicynodon tigriceps, $\frac{1}{2}$ nat. size: 2 Nythosaurus larvatus.

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Fig. 3.

Fig. 1.

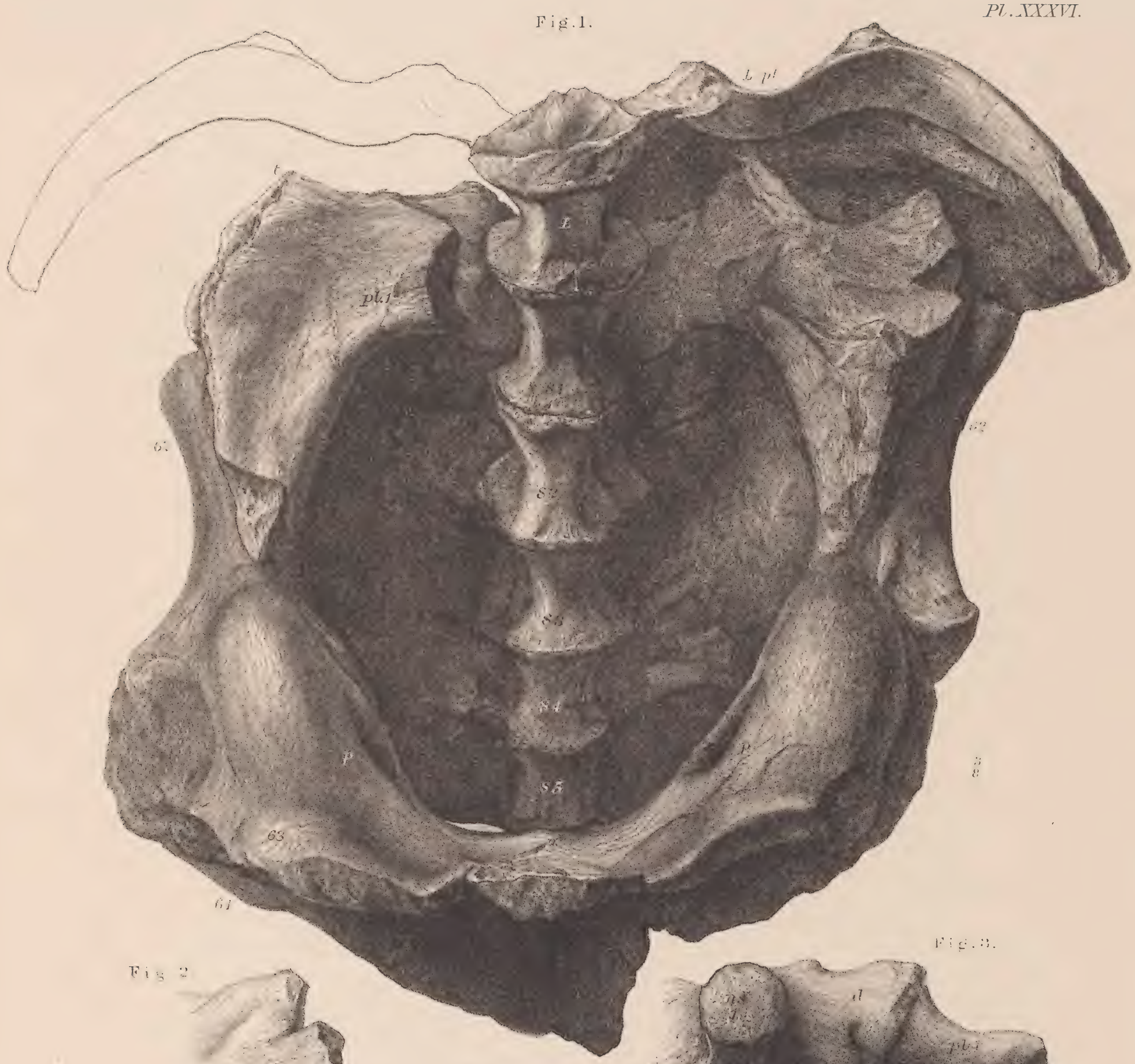
Fig. 2.

C. L. Griesbach.

Mintern Bros. imp.

Fig. 1, Dicynodon tigriceps, ½ nat. size: fig. 2 ib. nat. size: fig. 3, Dicynodon pardiceps nat. size.

Fig. 1.



Dicynodon tigriceps, three eighths nat. size.

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Fig. 1.

Fig. 2.

C.L. Griesbach

Mintern Bros. imp

Dicynodon tigriceps, three eighths nat. size.

Fig. 1.

Fig. 2.

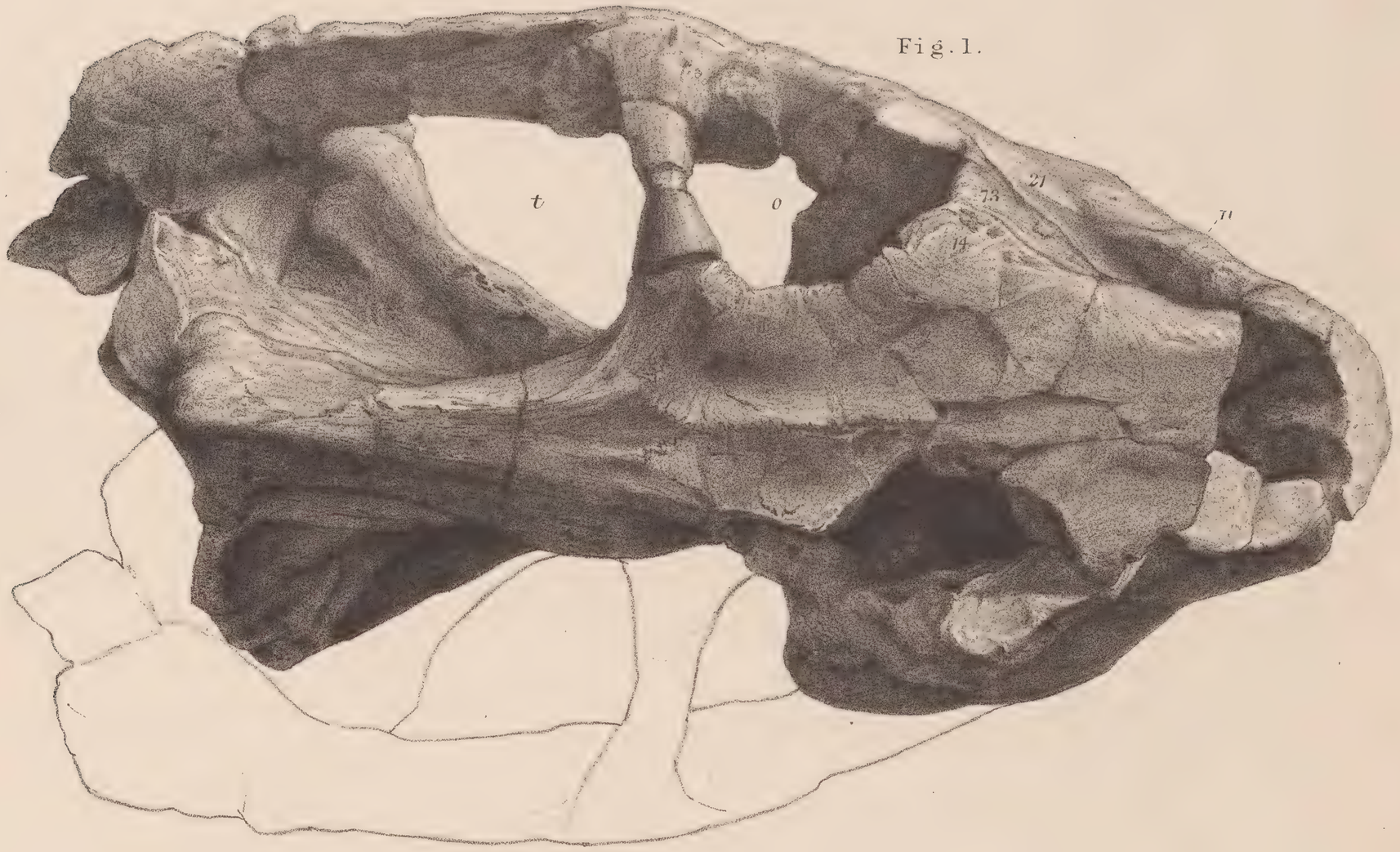
C.L.Griesbach.

Dicynodon pardiceps, Fig. 1, nat. size: 2 half nat. size.

Mintern Bros imp

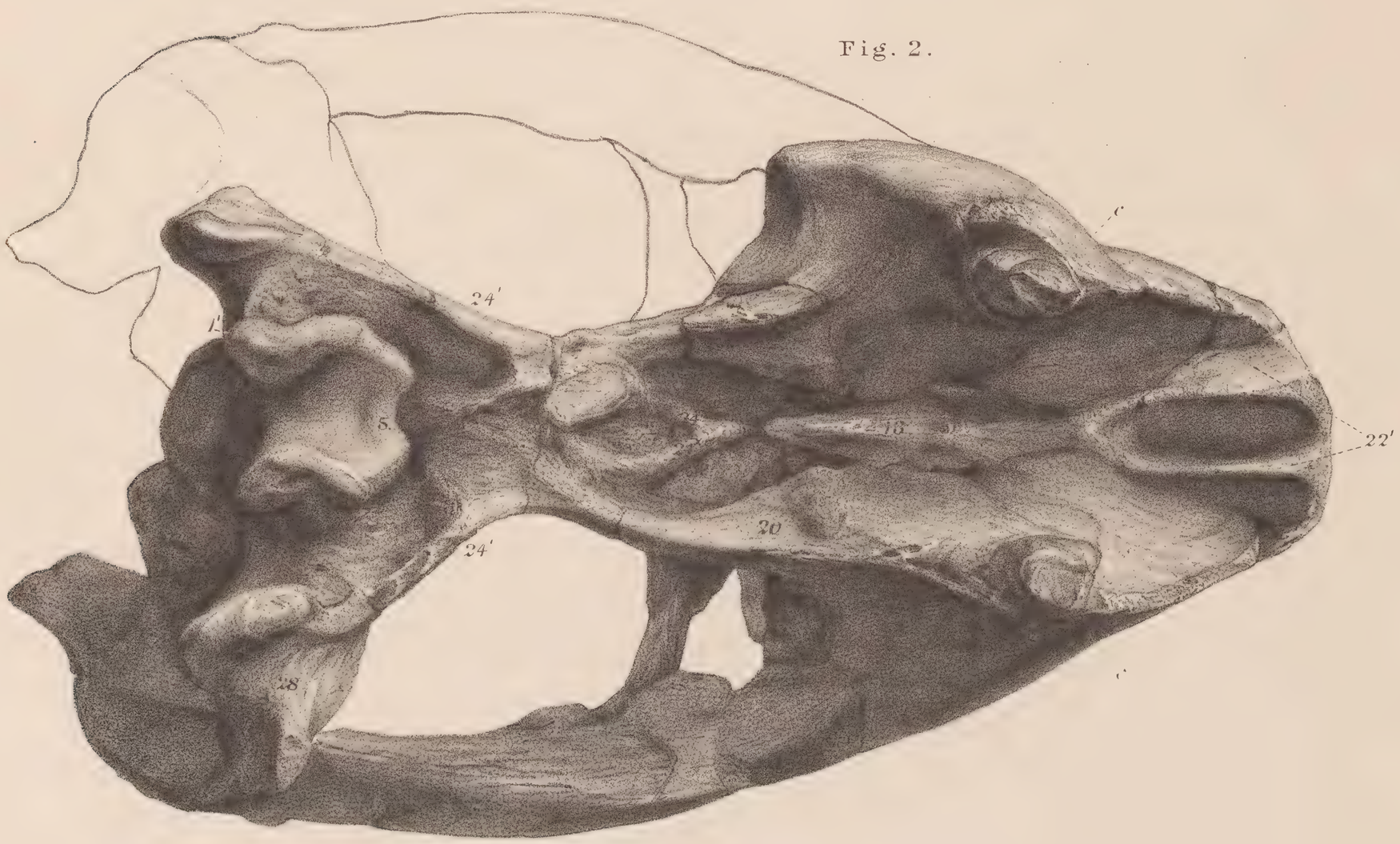
PA USA

Fig. 1.



$\frac{1}{2}$

Fig. 2.



C. L. Griesbach.

Mintern Bros. imp.

Dicynodon pardiceps, $\frac{1}{2}$ *nat. size.*

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Fig. 1.

Fig. 2.

C. L. Griesbach.

Mintern Bros. imp.

Dicynodon rectidens.

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Fig. 1.

Fig. 2.

Mintern Bros. imp.

Dicynodon pardiceps.

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Fig. 1.

Fig. 2.

C.L.Griesbach.

Mintern Bros. Imp.

Dicynodon pardiceps.

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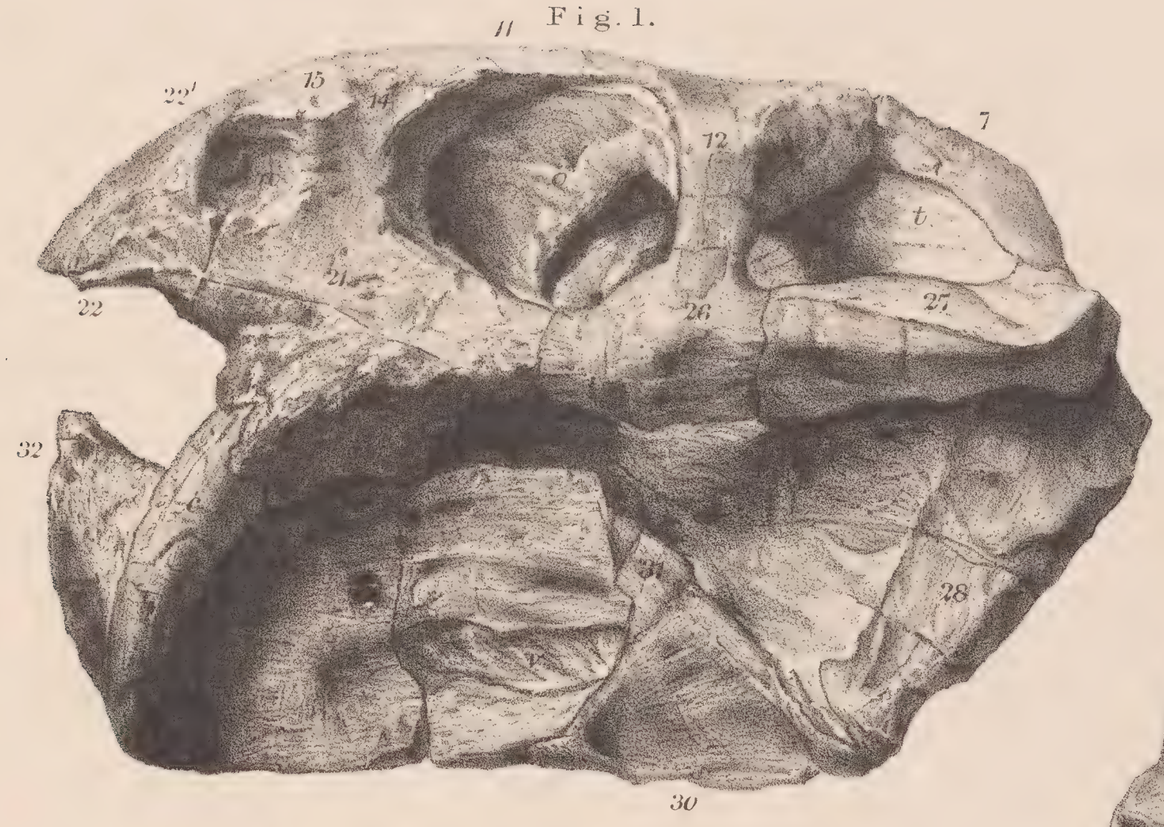
Fig. 1.



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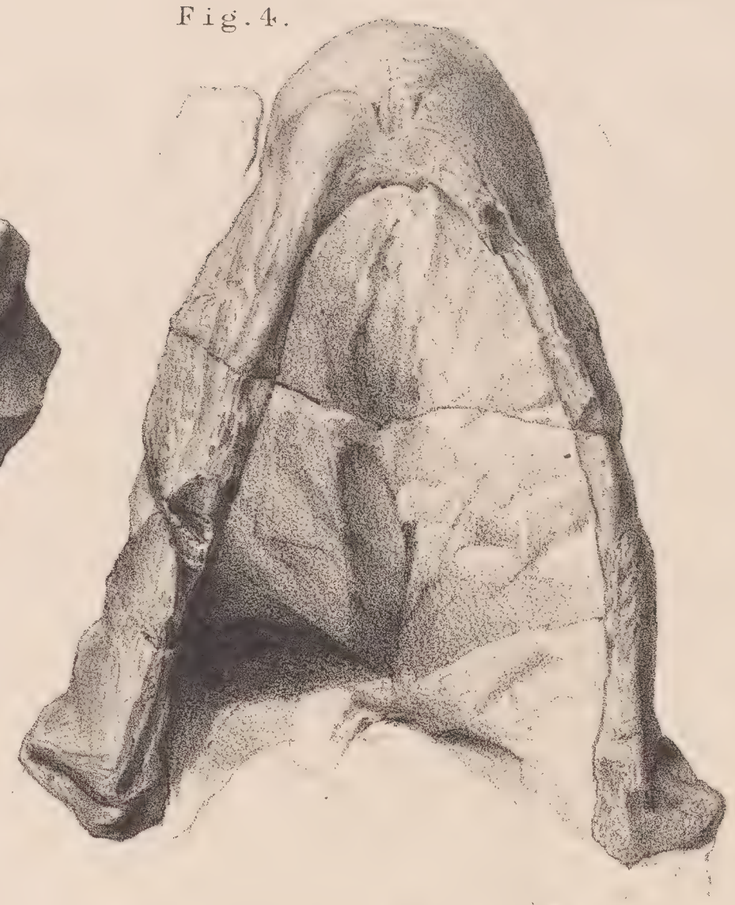


Fig. 5.

Fig. 6.

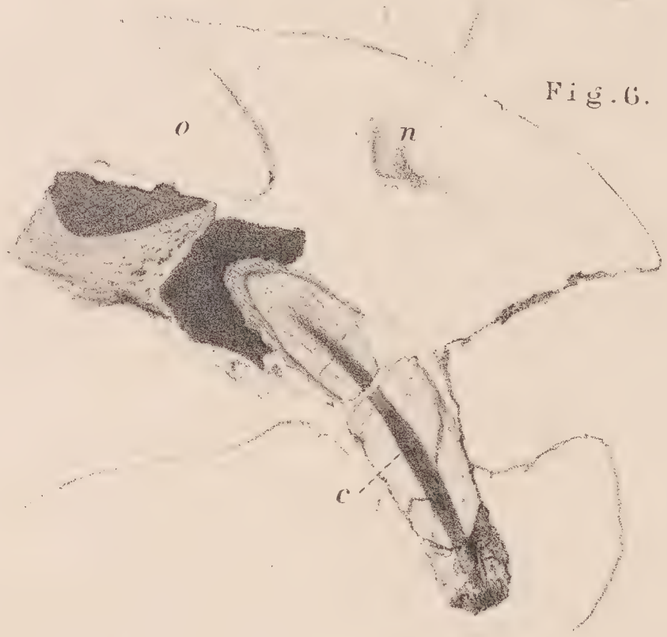
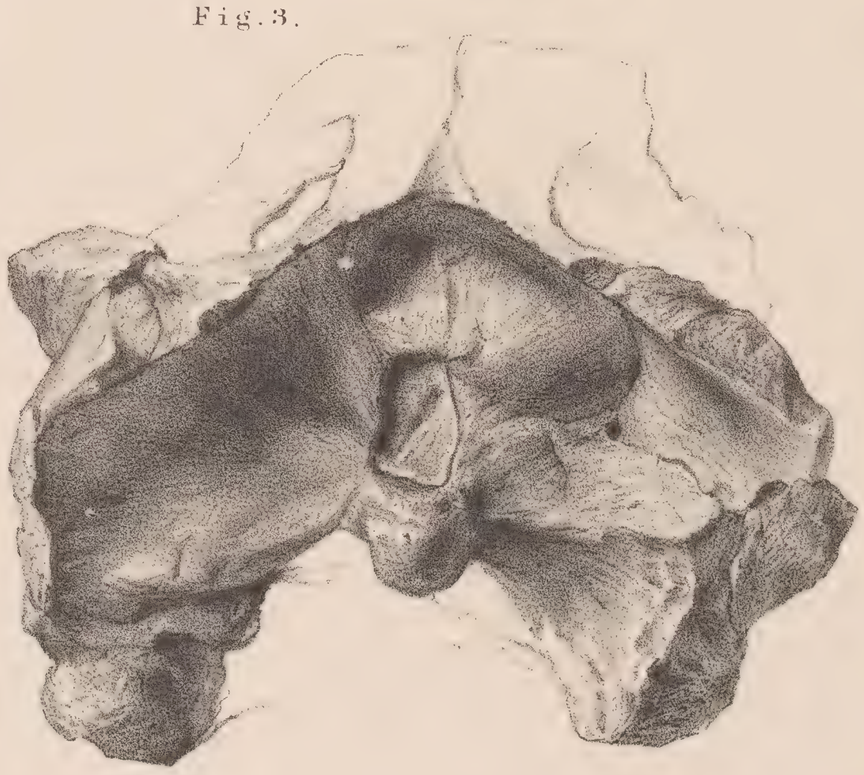


Fig. 2.

Fig. 3.



C.L. Griesbach.

Mintern Bros. imp.

Dicynodon feliceps.

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Fig. 1.

Fig. 3.

Fig. 2.

Fig. 4.

C.L. Griesbach.

Mintern Bros. imp.

Figs. 1. 2 & 3. Dicynodon testudiceps: 4. Plychognathus strigiceps.

Fig. 1.

Fig. 3.

Fig. 2.

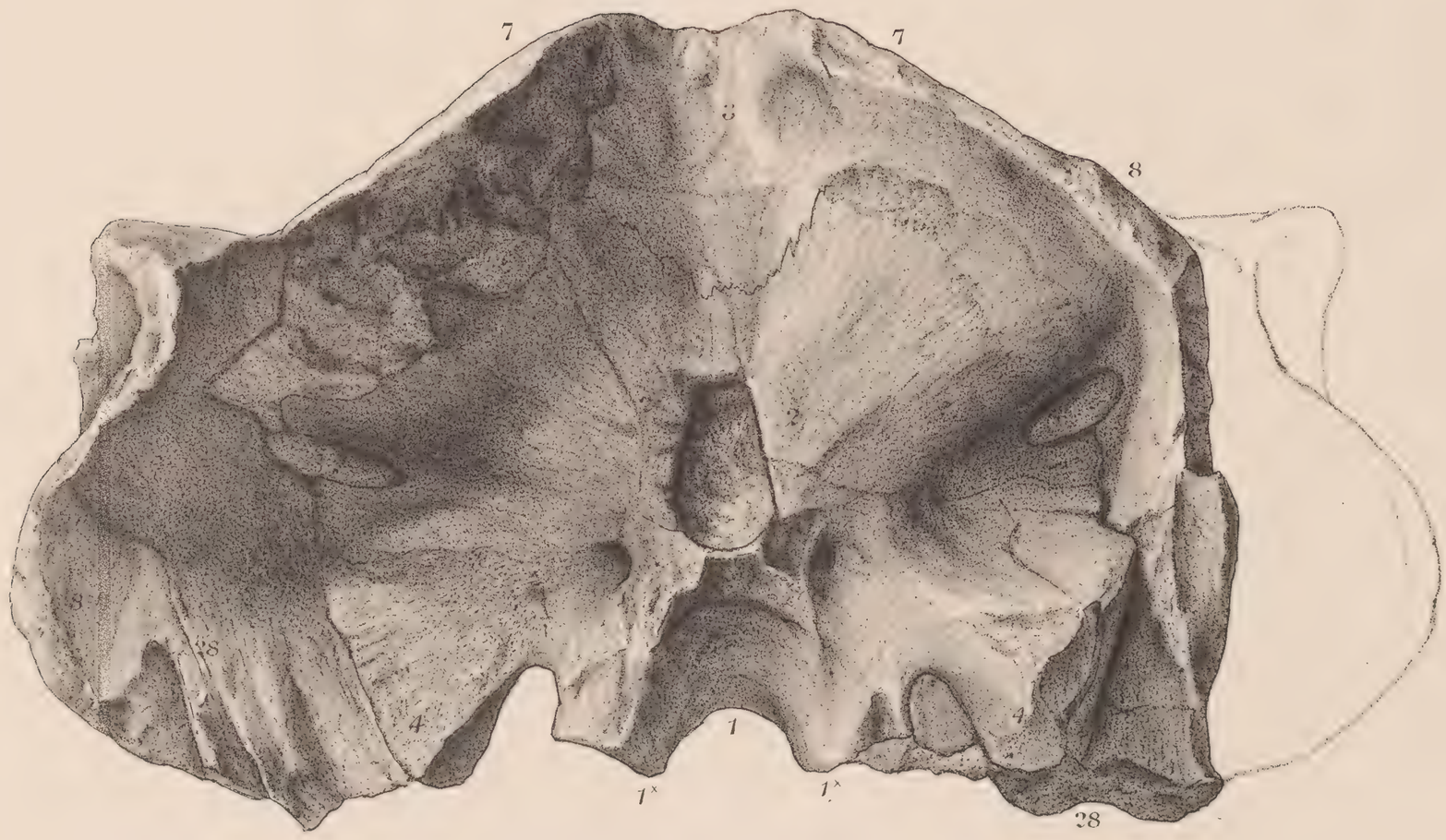
C. L. Griesbach.

Mintern Bros. imp.

Ptychognathus declivis.

Fig. 1.

Fig. 2.



C.L.Griesbach

Mintern Bros. imp.

Fig. 1 Ptychognathus declivis; 2 Ptychognathus latirostris.

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Fig. 1.

Fig. 2.

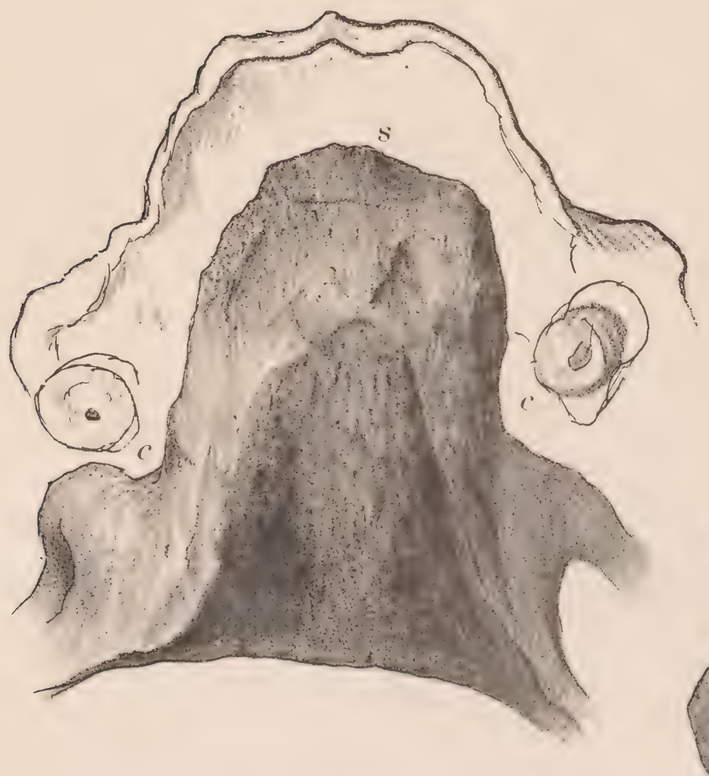

Fig. 3.

C.L.Griesbach.

Ptychognathus latirostris.

Mintern Bros. imp.

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Fig. 1.

Fig. 2.

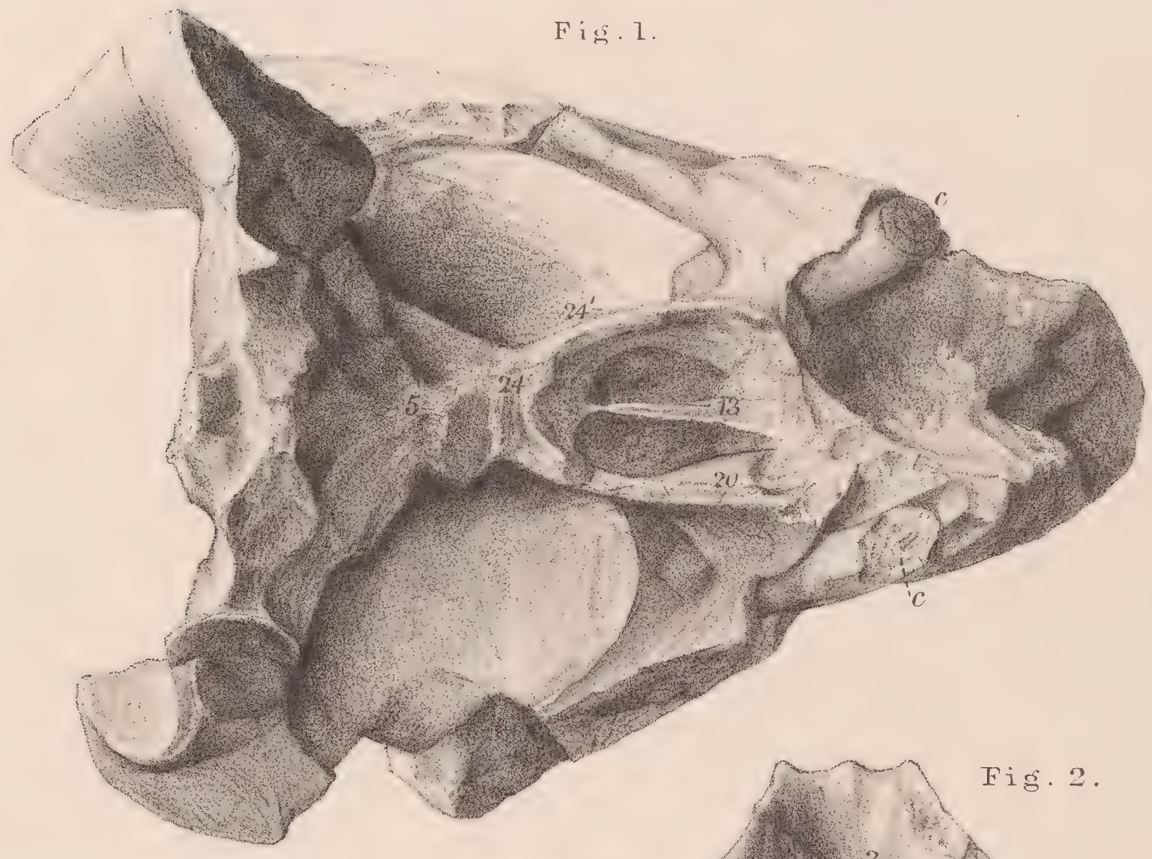
C.L. Griesbach.

Mintern Bros. imp.

Fig. 1 Ptychognathus boopis; 2 Ptychognathus latirostris.

U.S.A

Fig. 1.



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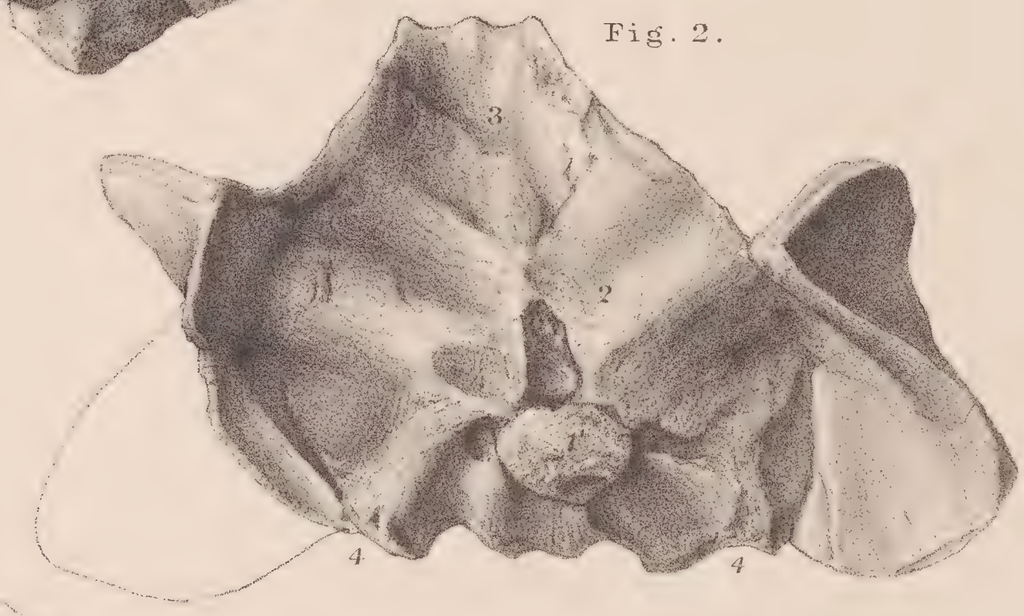

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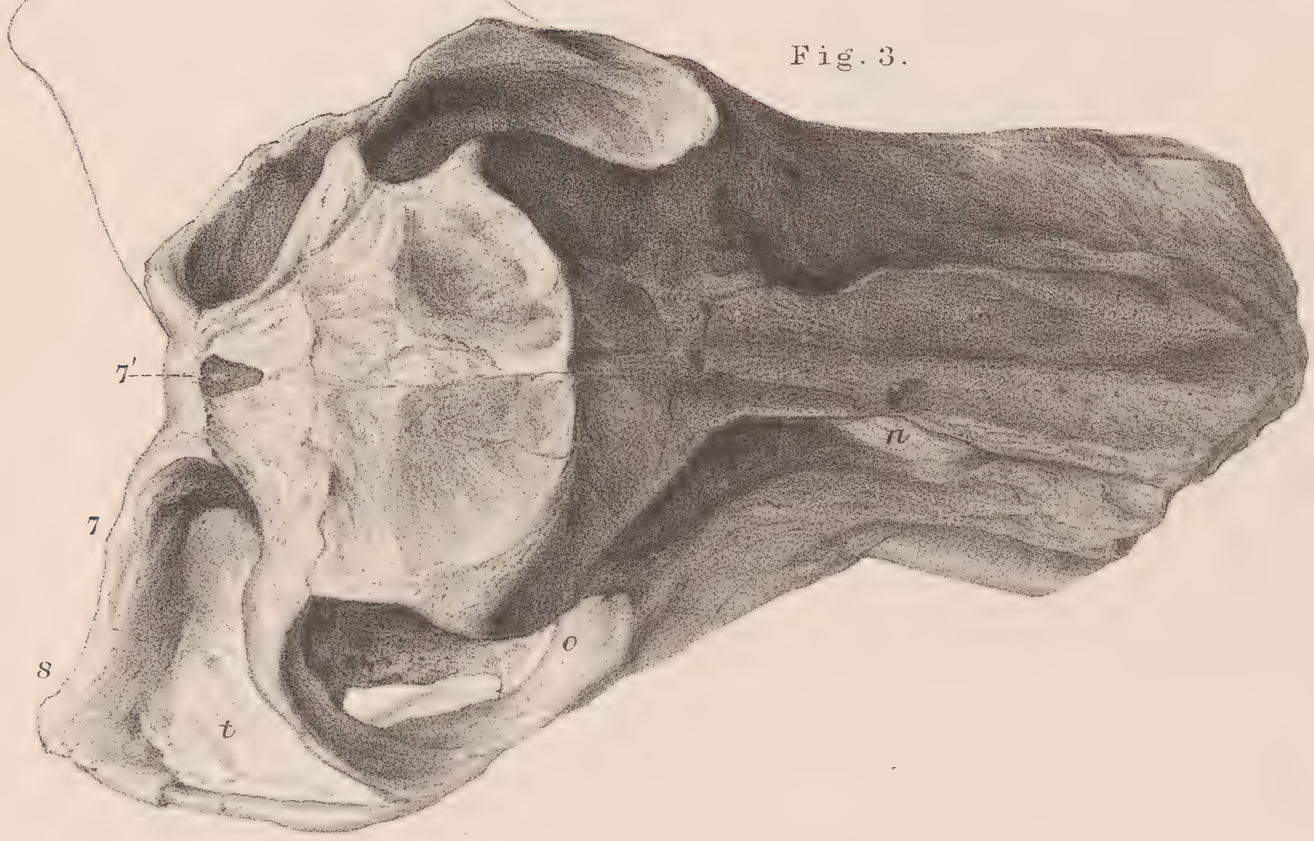

C.L. Griesbach.

Mintern Bros.

Ptychognathus hoopis.

Pl. L.

Fig. 1.

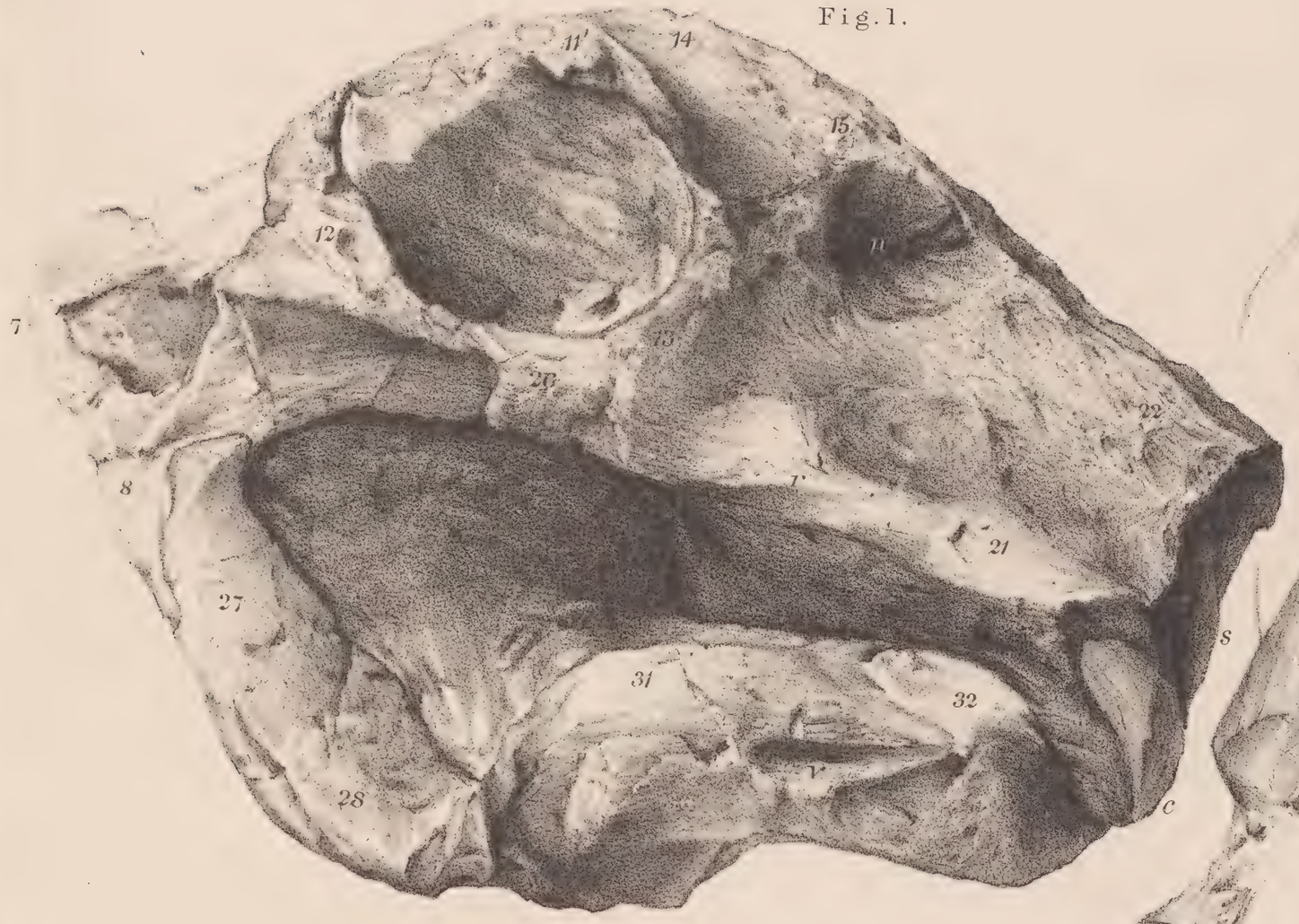

Fig. 4.

Fig. 2.

Fig. 5.

Fig. 6.

Fig. 3.

C.L. Griesbach.

Mintern Bros. imp.

Ptychognathus Alfredi.

Fig. 1.

Fig. 3.

Fig. 2.

C.L. Griesbach.

Mintern Bros. imp.

Ptychognathus depressus; Fig. 3 $\frac{2}{3}^{ds}$ nat. size.

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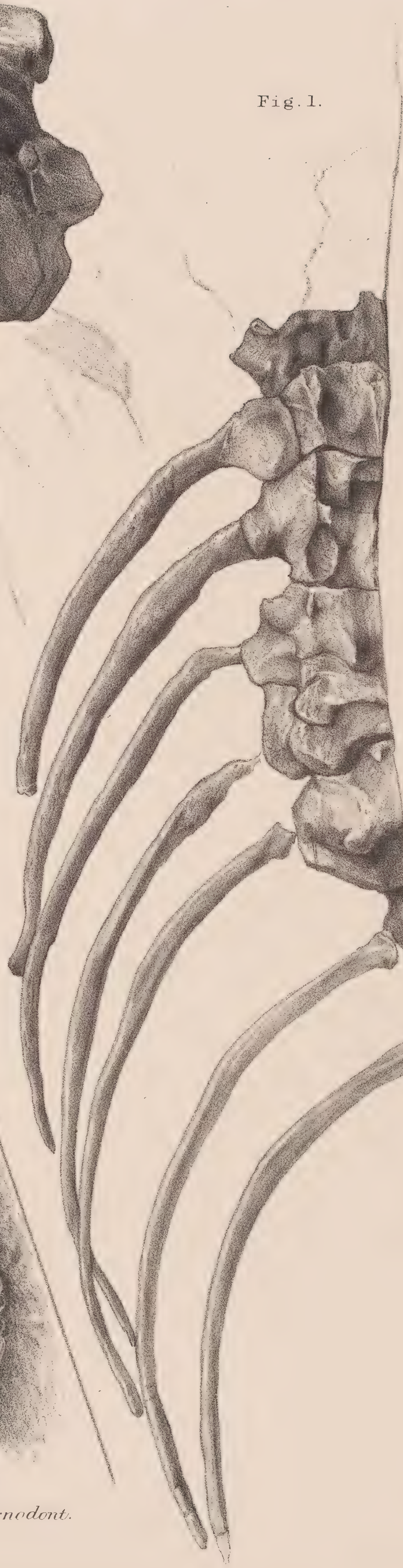
Fig. 1.



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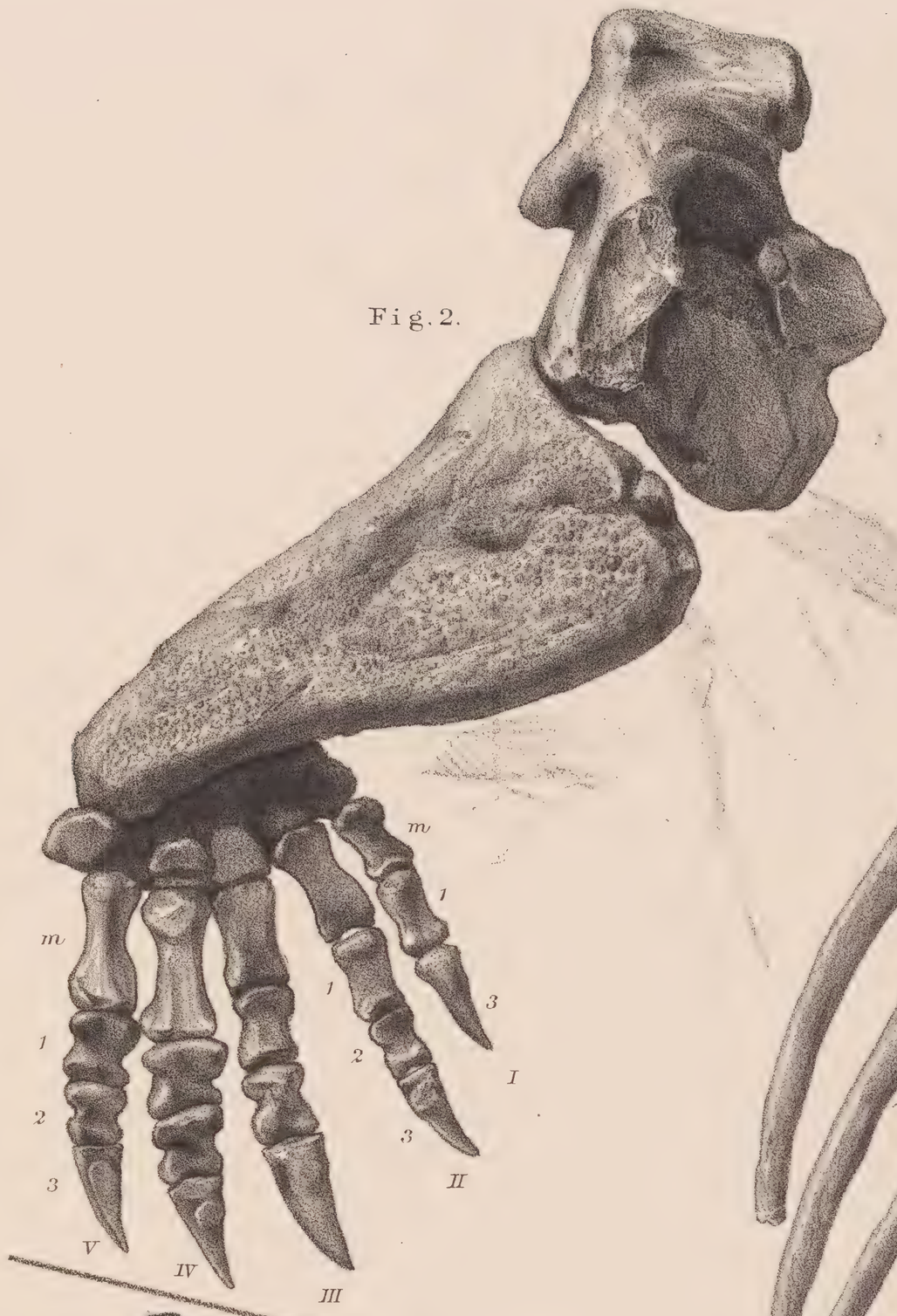

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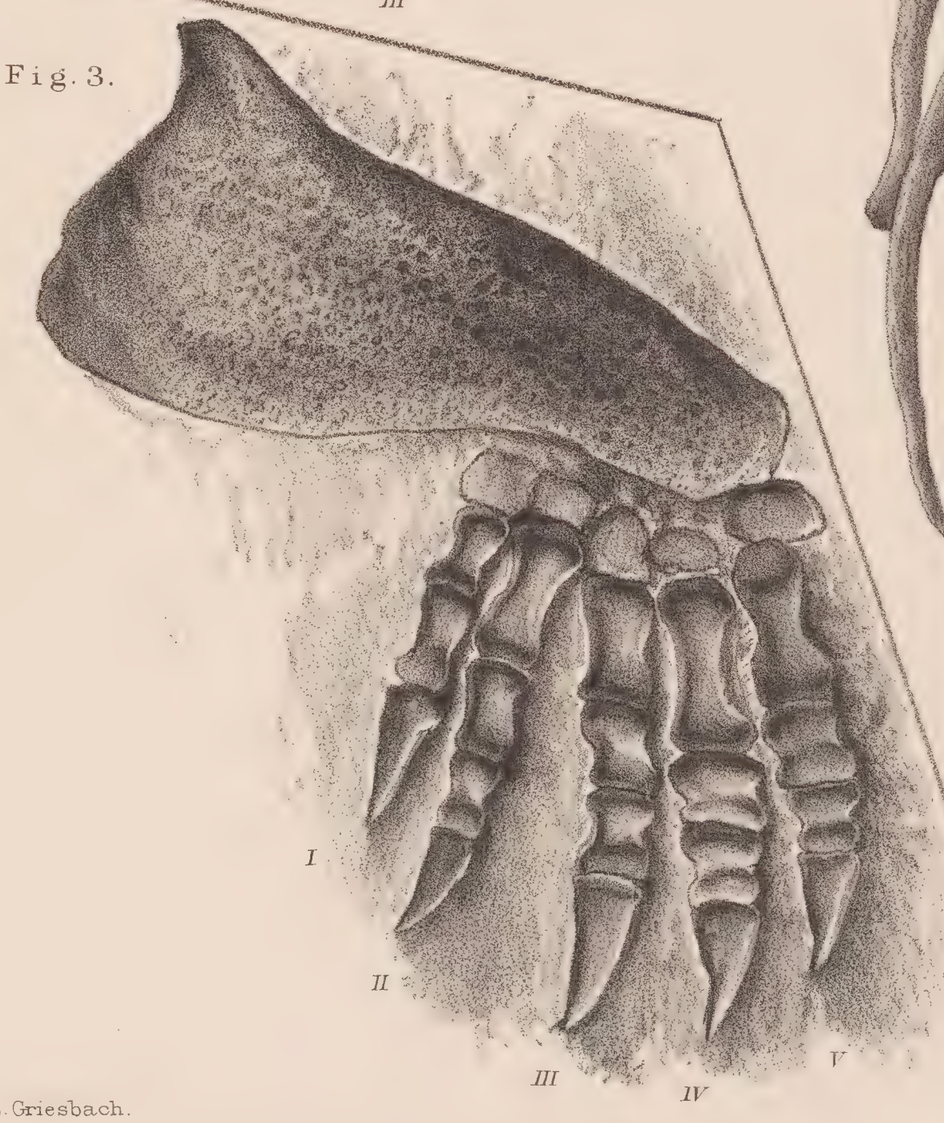


C.L. Griesbach.

Mintern Bros. imp.

Dicynodont.

UNIV
CITY
CA USA

Fig. 1.

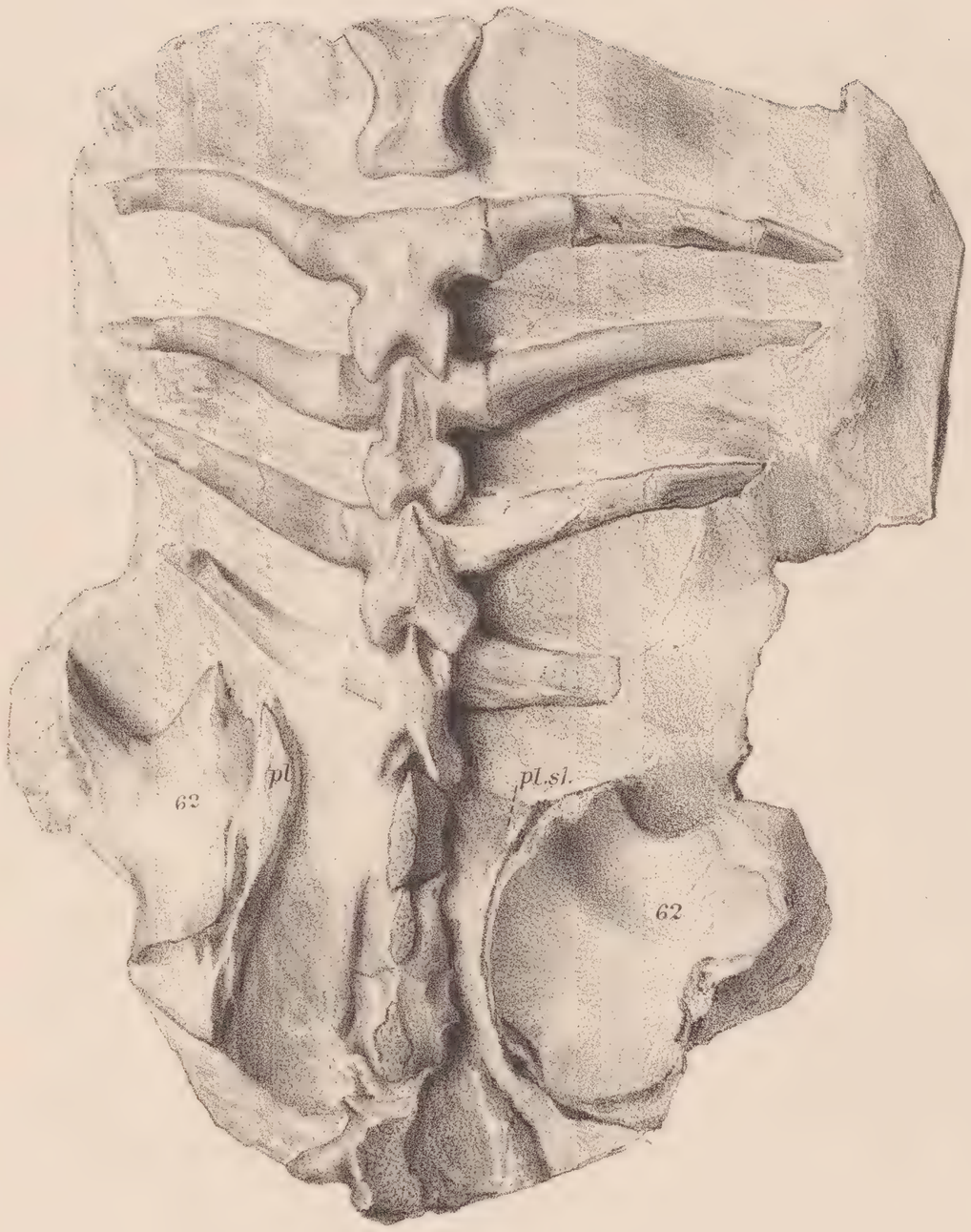
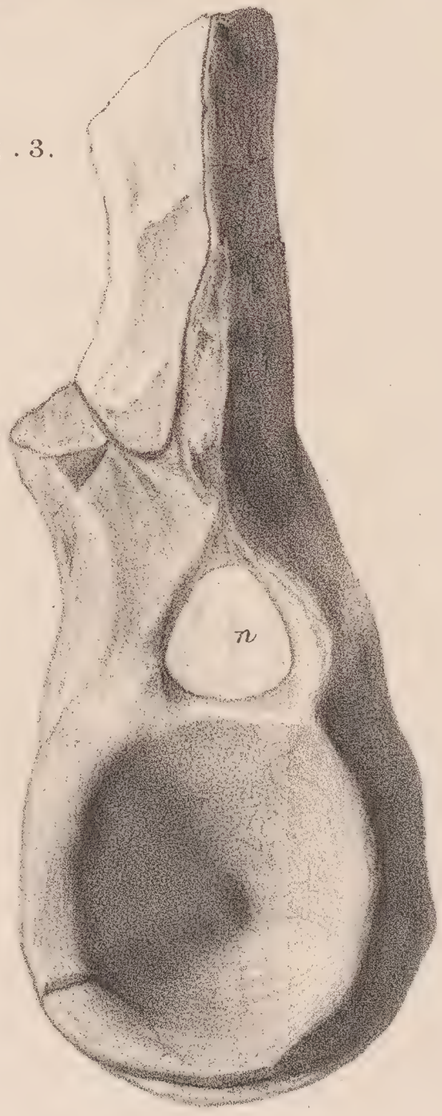


Fig. 2.

Fig. 3.



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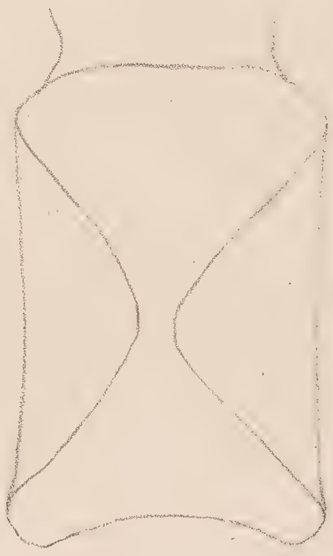

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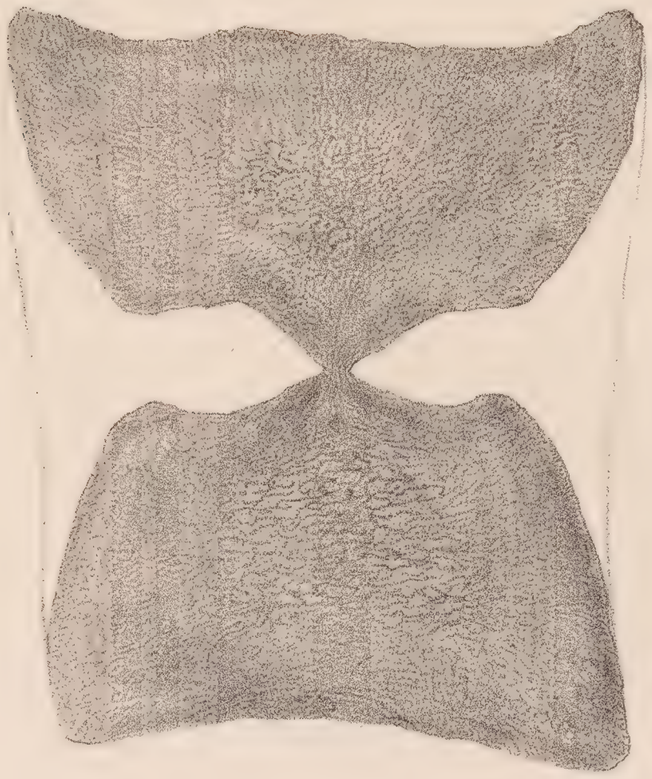

C.L.Griesbach.

Mintern Bros. imp.

Fig. 1. Ptychognathus (?) pusillus: 2–4. Dicynodon pardiceps: 5. Pareiasaurus bombidens

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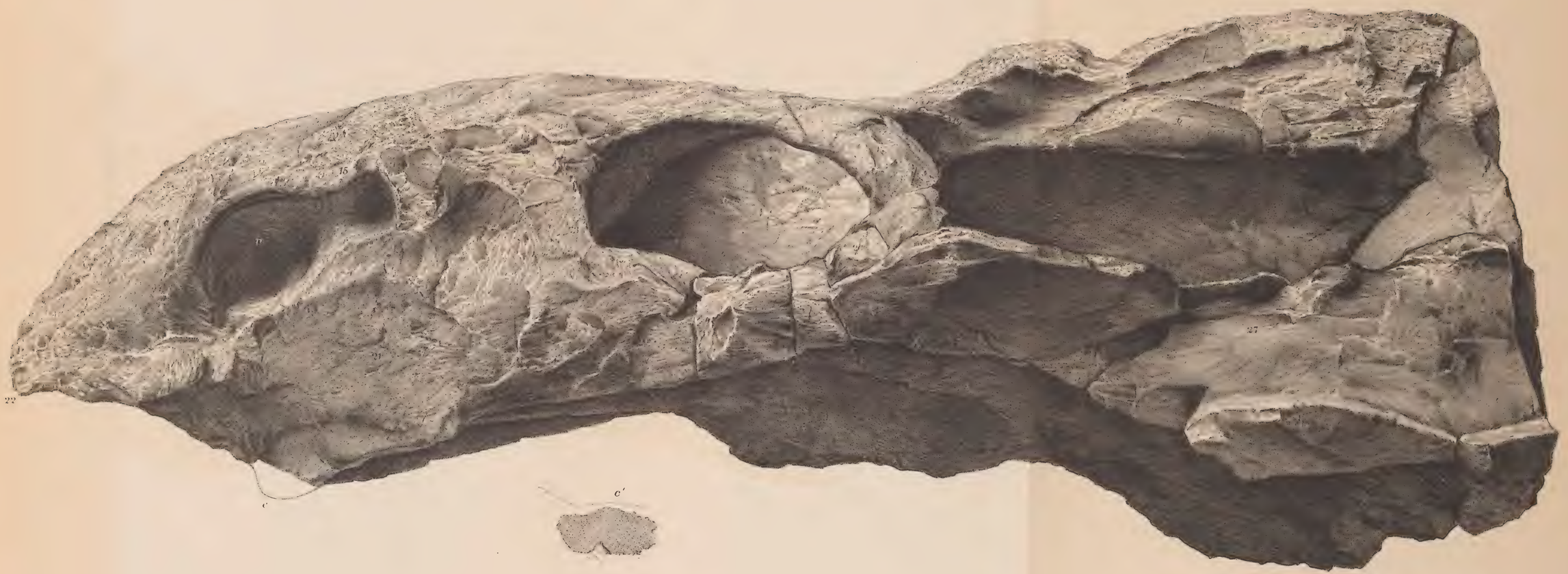
C L Griesbach



C. L. Griesbach

Oudenodon magnus.

Mintern Bros. imp.

$\frac{1}{2}$

C.L. Griesbach.

Oudenodon magnus, $\frac{1}{2}$ *nat. size.*

Mintern Bros. imp.

Fig. 1.

Fig. 2.

C.L. Griesbach.

Mintern Bros. imp.

Fig. 1 Oudenodon magnus, ½ nat. size: Fig. 2 Oudenodon Bainii, nat. size.

C.L. Griesbach.

Quadrandem megames.

Mitchell Prss. imp.

Pl. LVII.

Mintern Bros. imp.

Oudenodon magnus.

Fig. 1.

1/2

Fig. 2.

C.L.Griesbach.

Mintern Bros. imp.

Oudenodon brevirostris, $\frac{1}{2}$ *nat. size.*

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CAMBRIDGE, MASS.

Fig. 1.

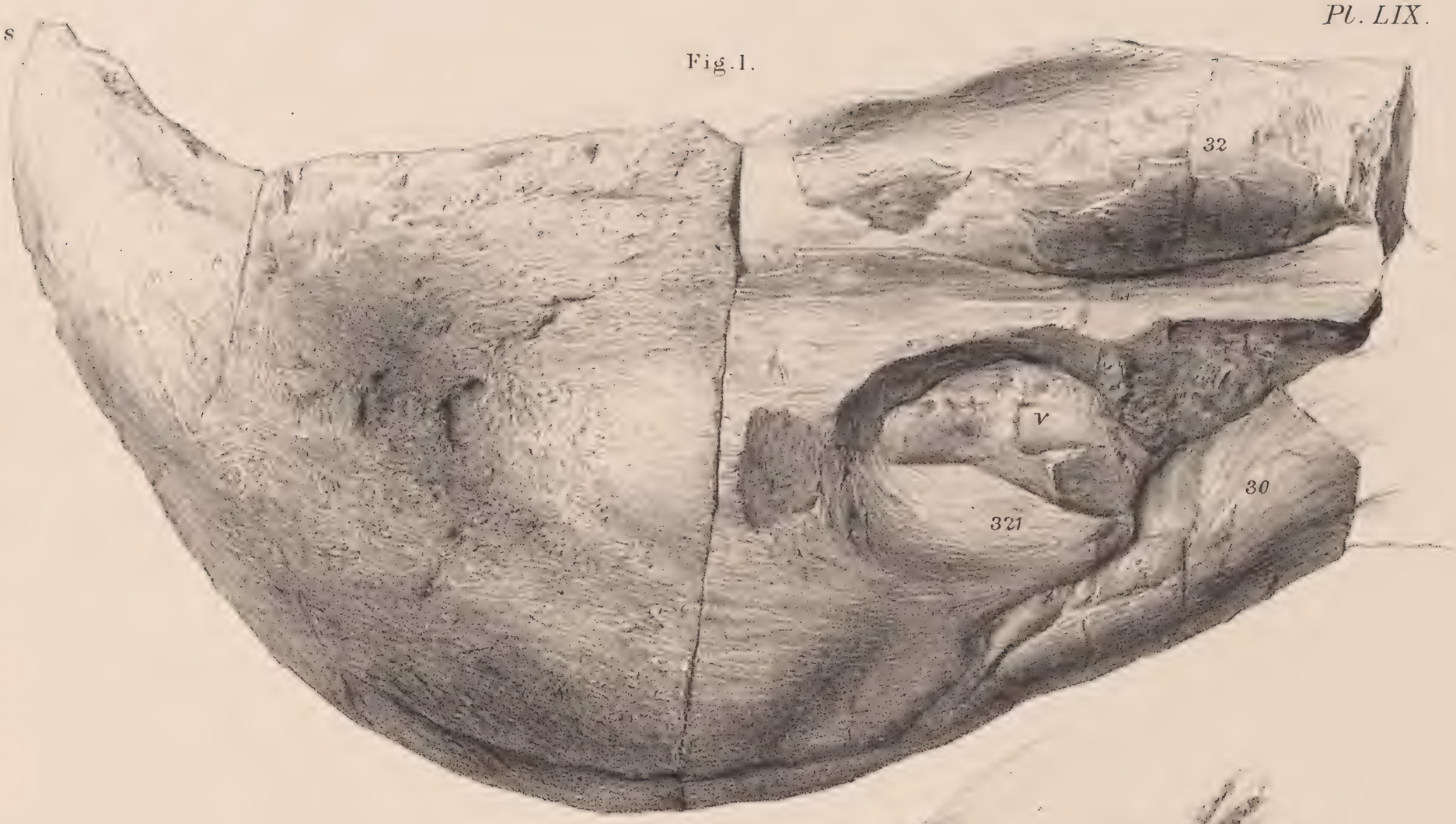
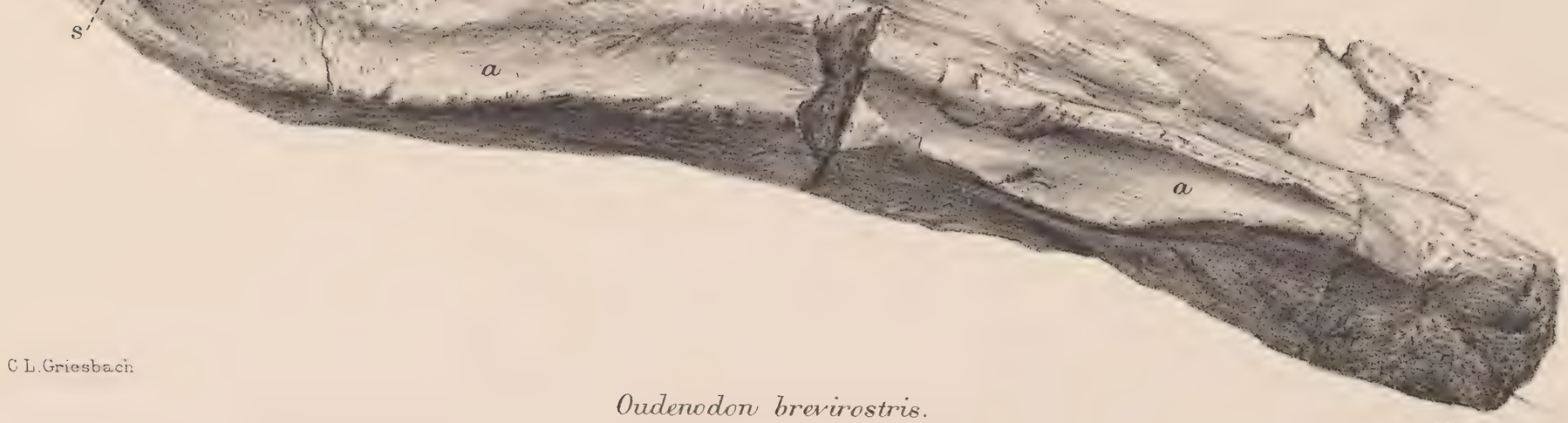


Fig. 2.

Fig. 3.



C L. Griesbach

Oudenodon brevirostris.

Mintern Bros. imp.

Fig. 1.

Fig. 3.

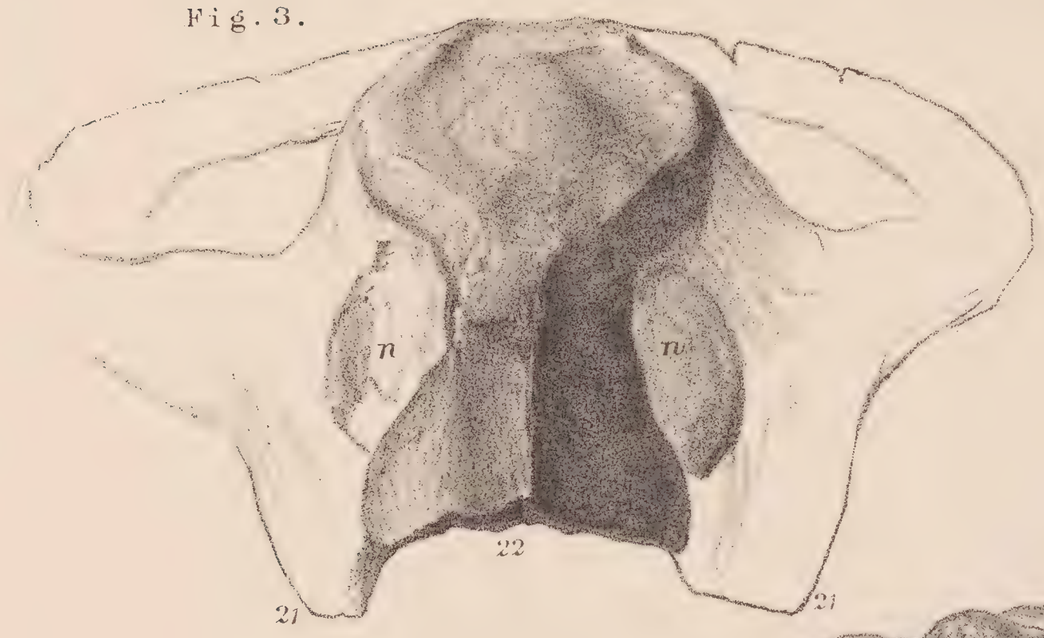


Fig. 2.

C.L. Griesbach.

Minter Bros. imp.

Oudenodon Bainii.

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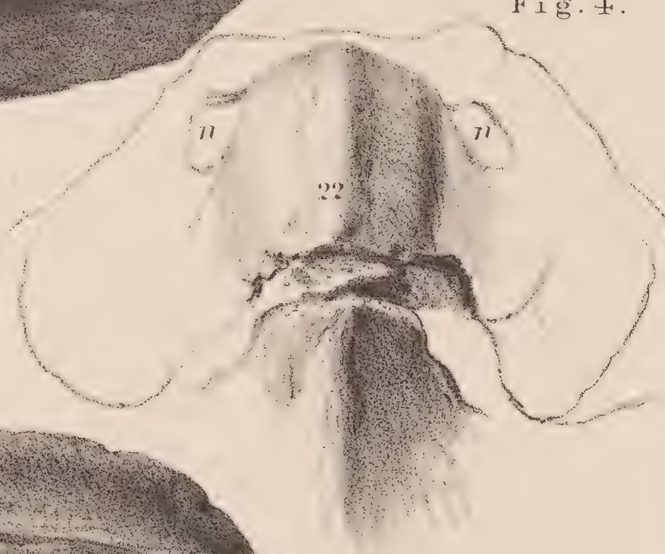
Fig. 1.

Fig. 2.

Fig. 4.



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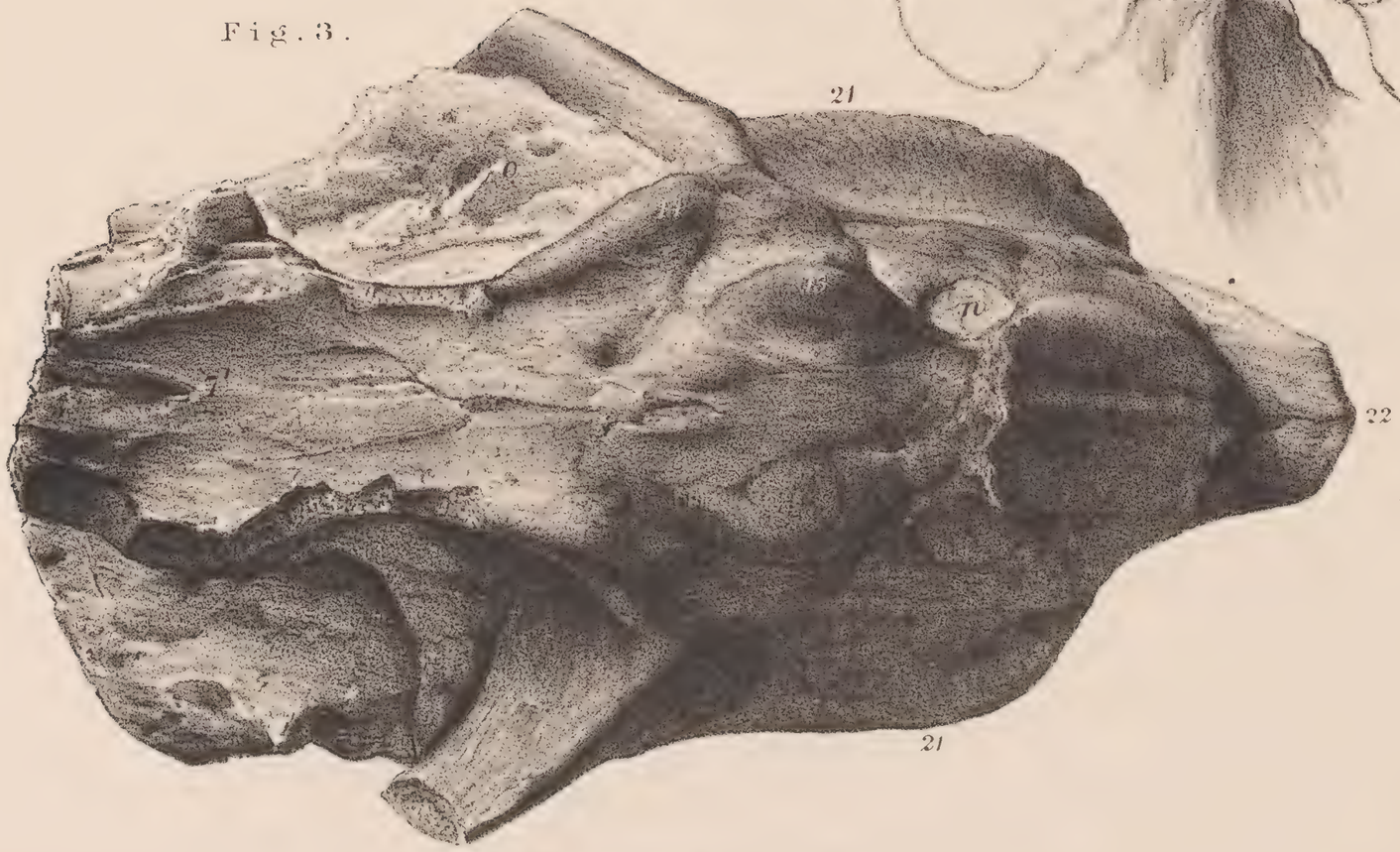

C.L.Griesbach.

Mintern Bros. imp.

Oudenodon prognathus.

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Fig. 1.

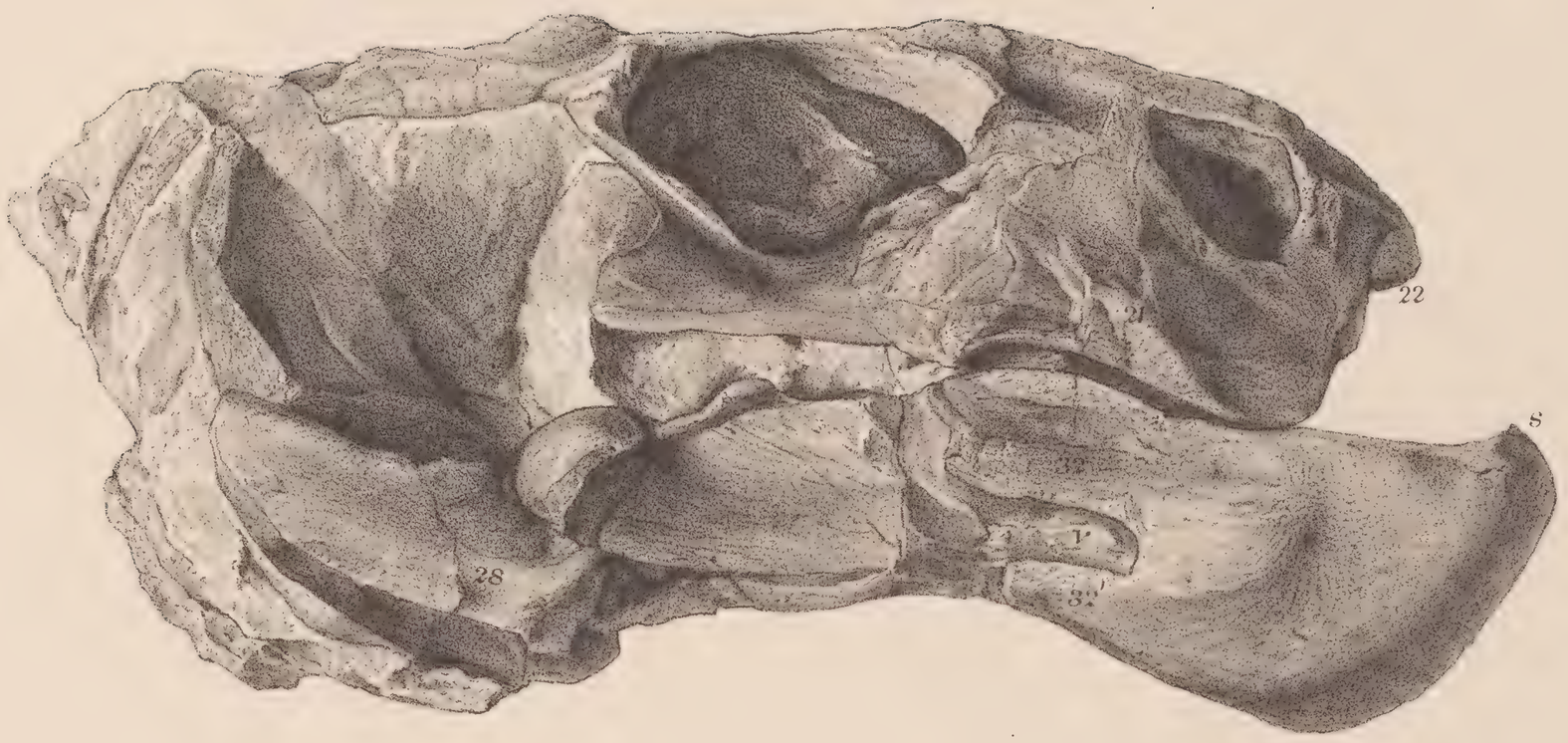

Fig. 2.

C. Lüdriesbach.

Mintern Bros. imp.

Oudenodon Grevi.

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Fig. 1.

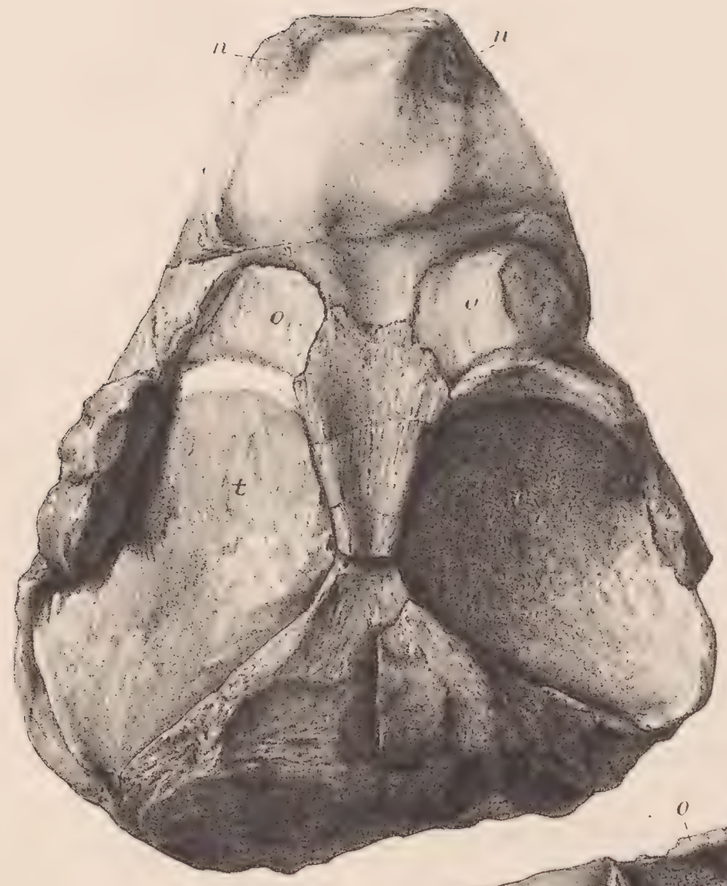


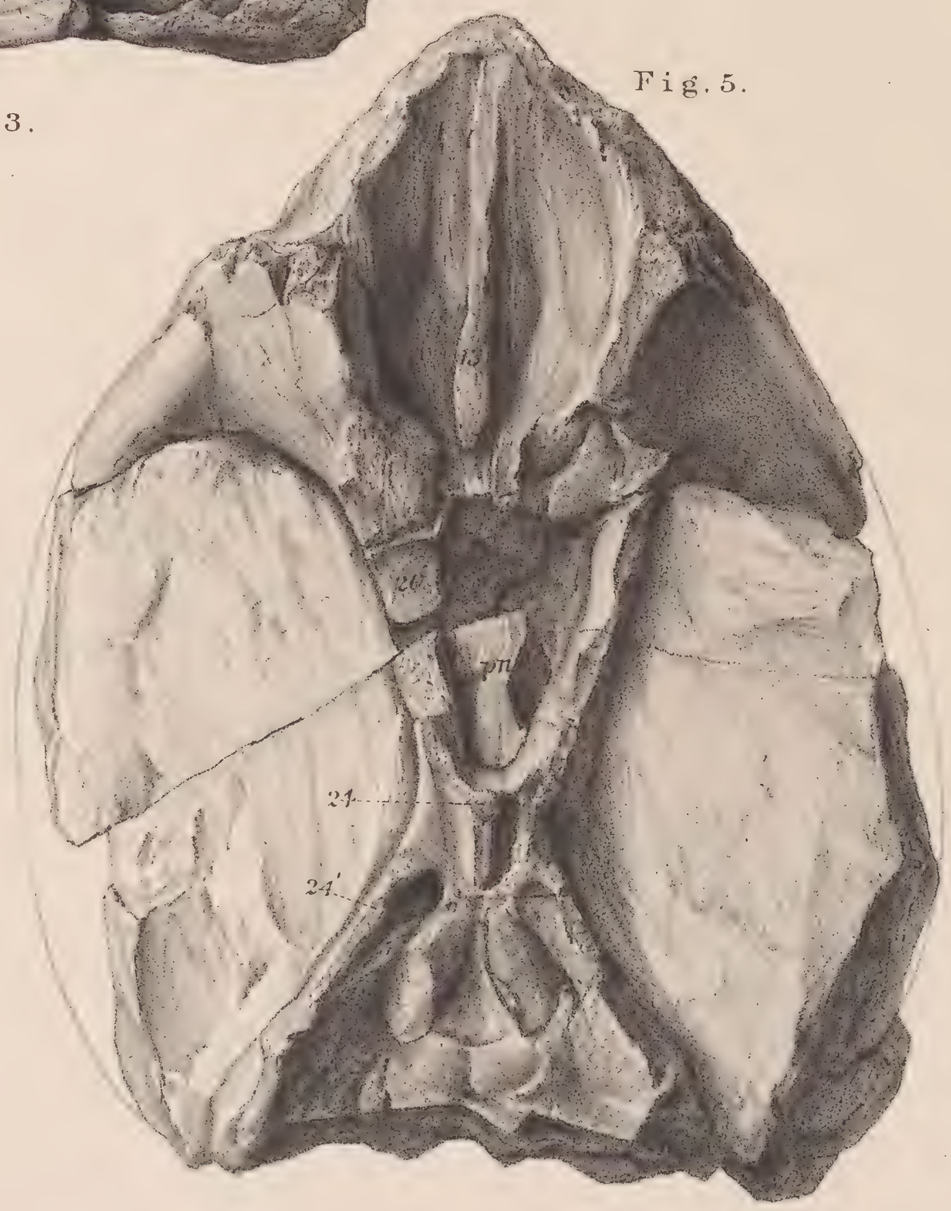
Fig. 2.

$\frac{1}{2}$

Fig. 3.

Fig. 4.

Fig. 5.



C.L. Griesbach.

Mintern Bros. imp.

Figs. 1-3 Theriognathus microps; Figs. 4, 5 Oudenodon megalops.

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Fig. 1.

Fig. 2.

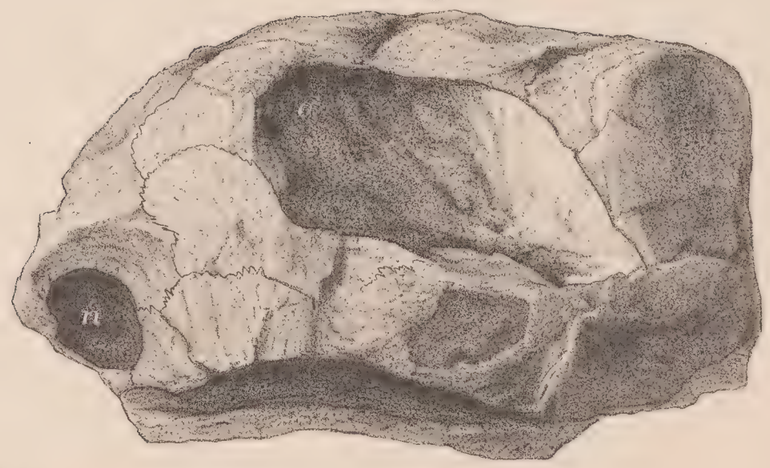
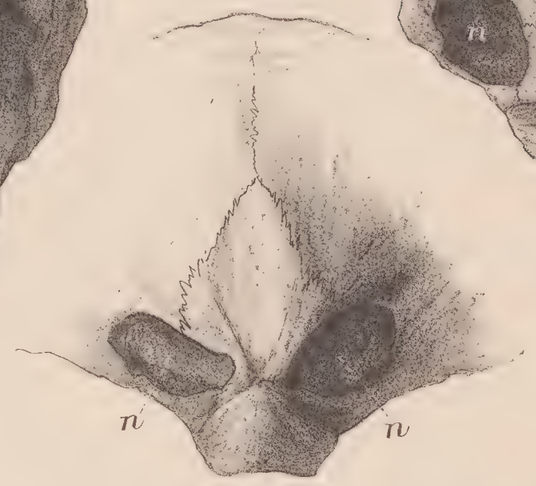


Fig. 3.



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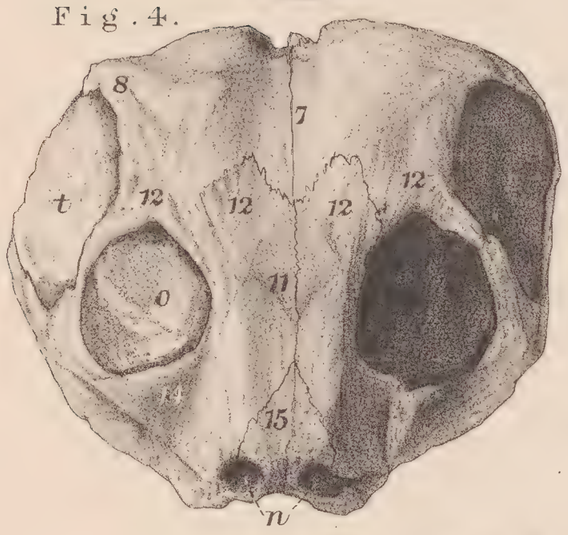

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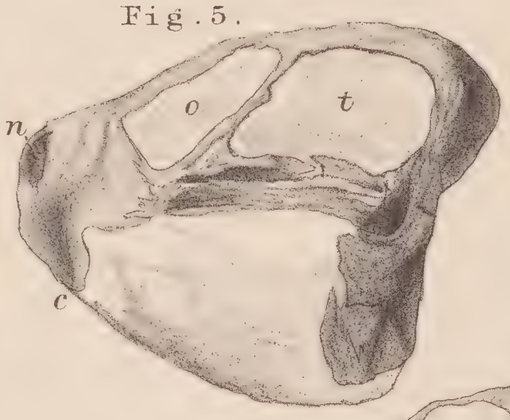

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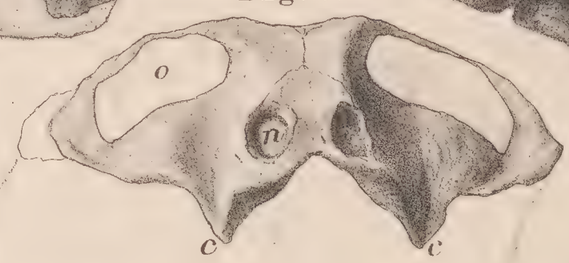


Fig. 8.

Fig. 9.

Fig. 13.

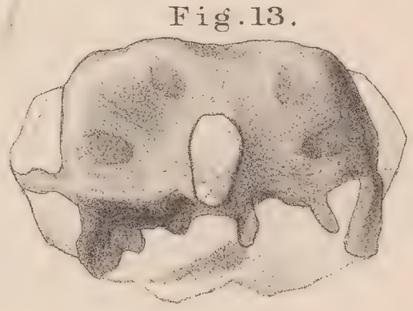
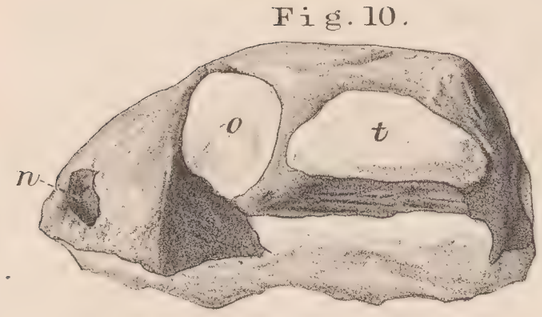


Fig. 12.

Fig. 10.



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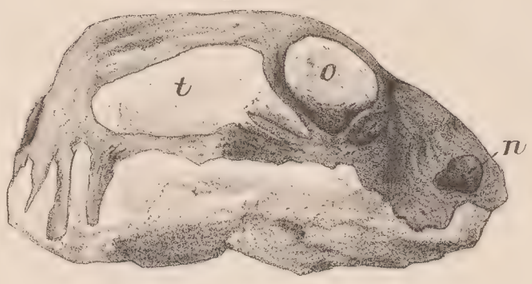

C.L.Griesbach.

Mintern Bros. imp.

Figs. 1–3 Kistecephalus leptorhinus; 4–7 Kistecephalus microrhinus; 8–9 Kist. chelydroides; 10–13 Kist. planiceps.

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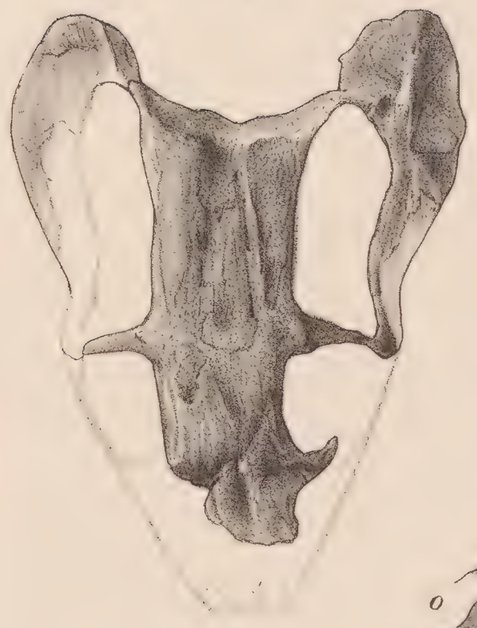
Fig. 1.



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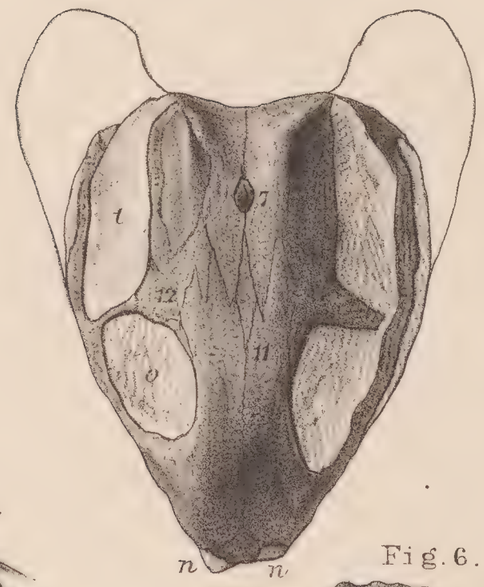
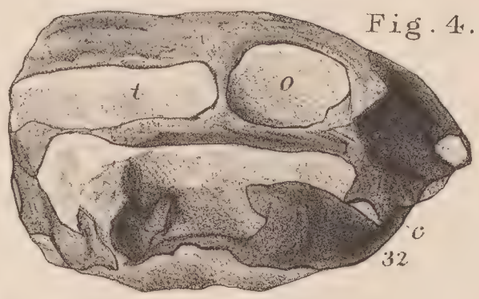


Fig. 3.

Fig. 4.



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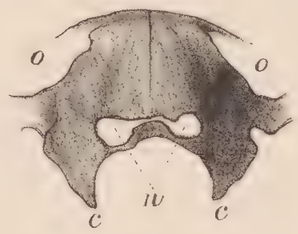

Fig. 6.

Fig. 7.

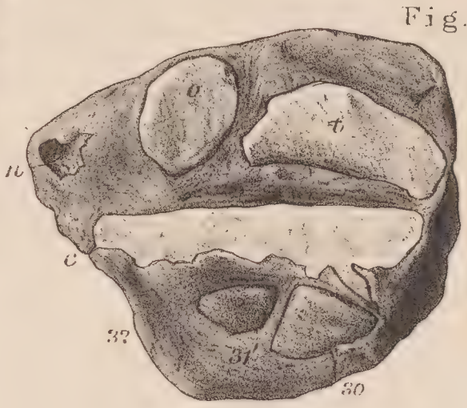

Fig. 8.

C.L. Griesbach.

Mintern Bros. imp.

Figs. 1–6 Kistecephalus arctatus; Fig. 7 Kistecephalus bathygnathus; Fig. 8 Oudenodon Greyi.

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C.L. Gresbach.

Endothiodon bathystoma.

Mintern Bros. imp.

Fig. 2.

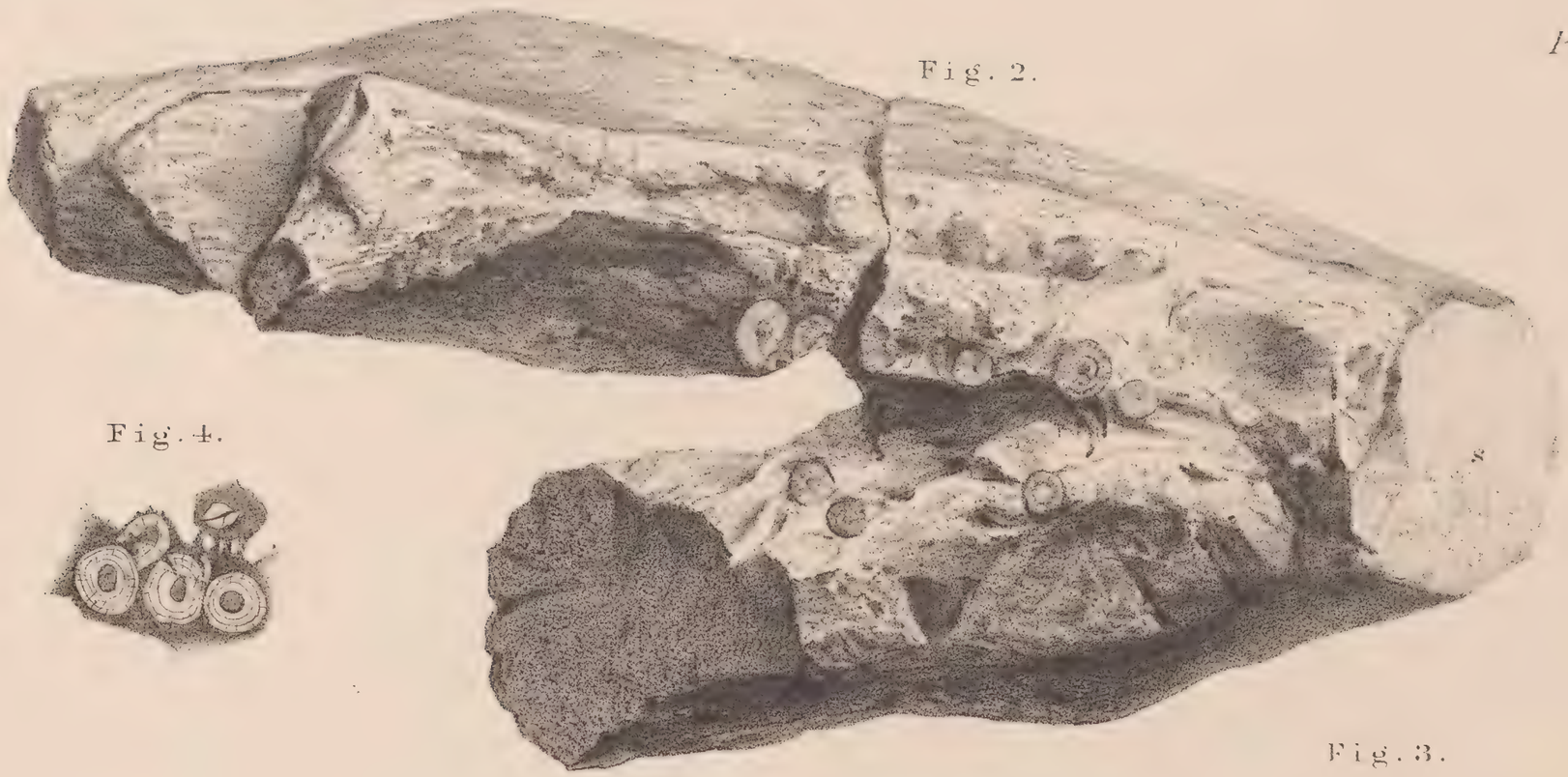
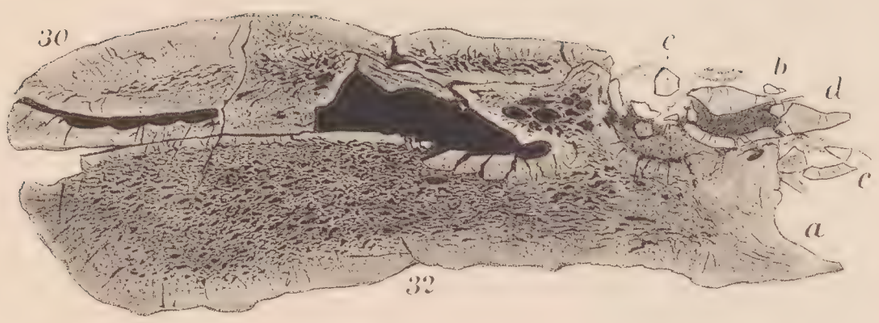


Fig. 4.

Fig. 3.

Fig. 5.



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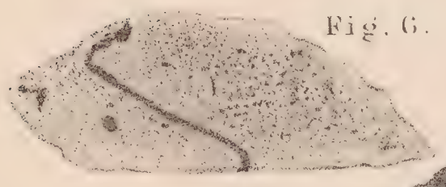

Fig. 1.

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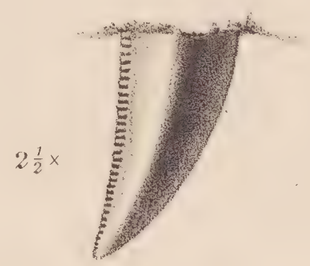
Endothiodon bathystoma.

Fig. 1.

Fig. 5.



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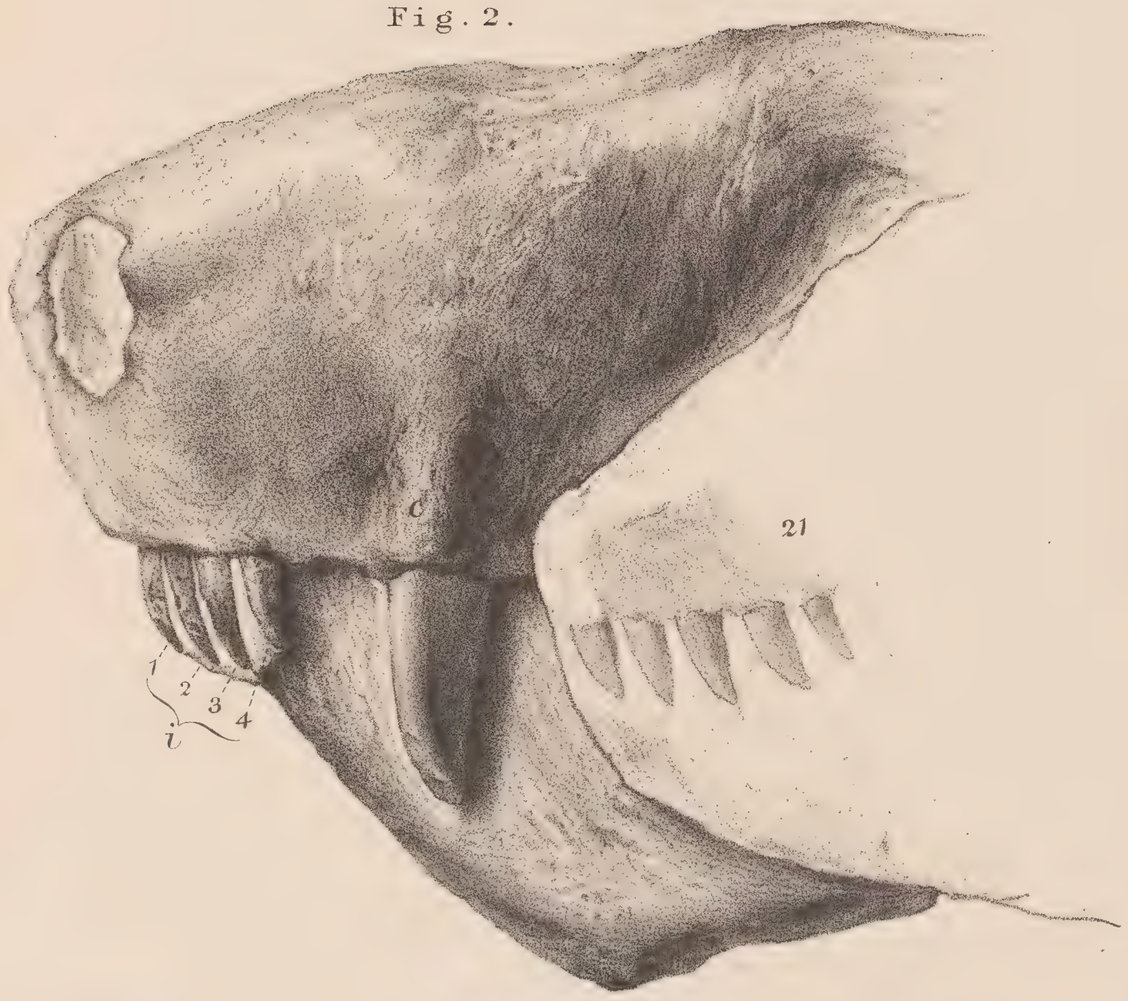

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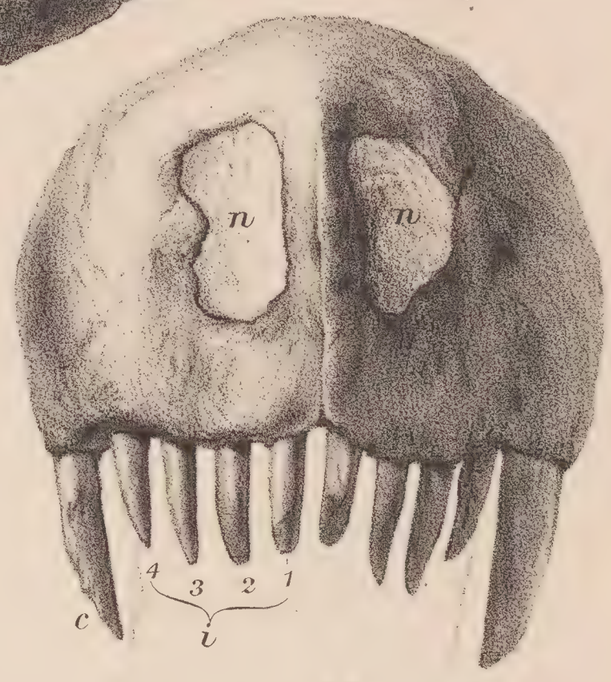

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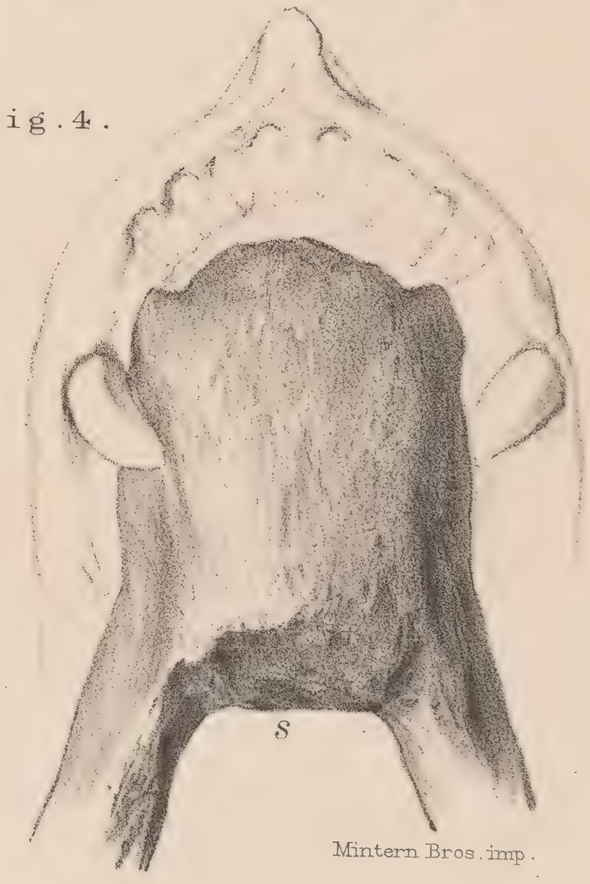

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Figs. 1.

Fig. 2.

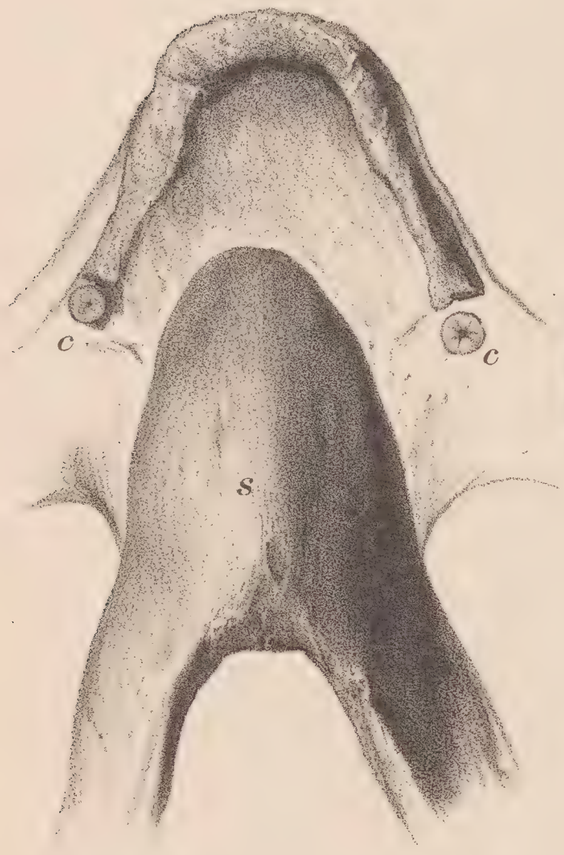
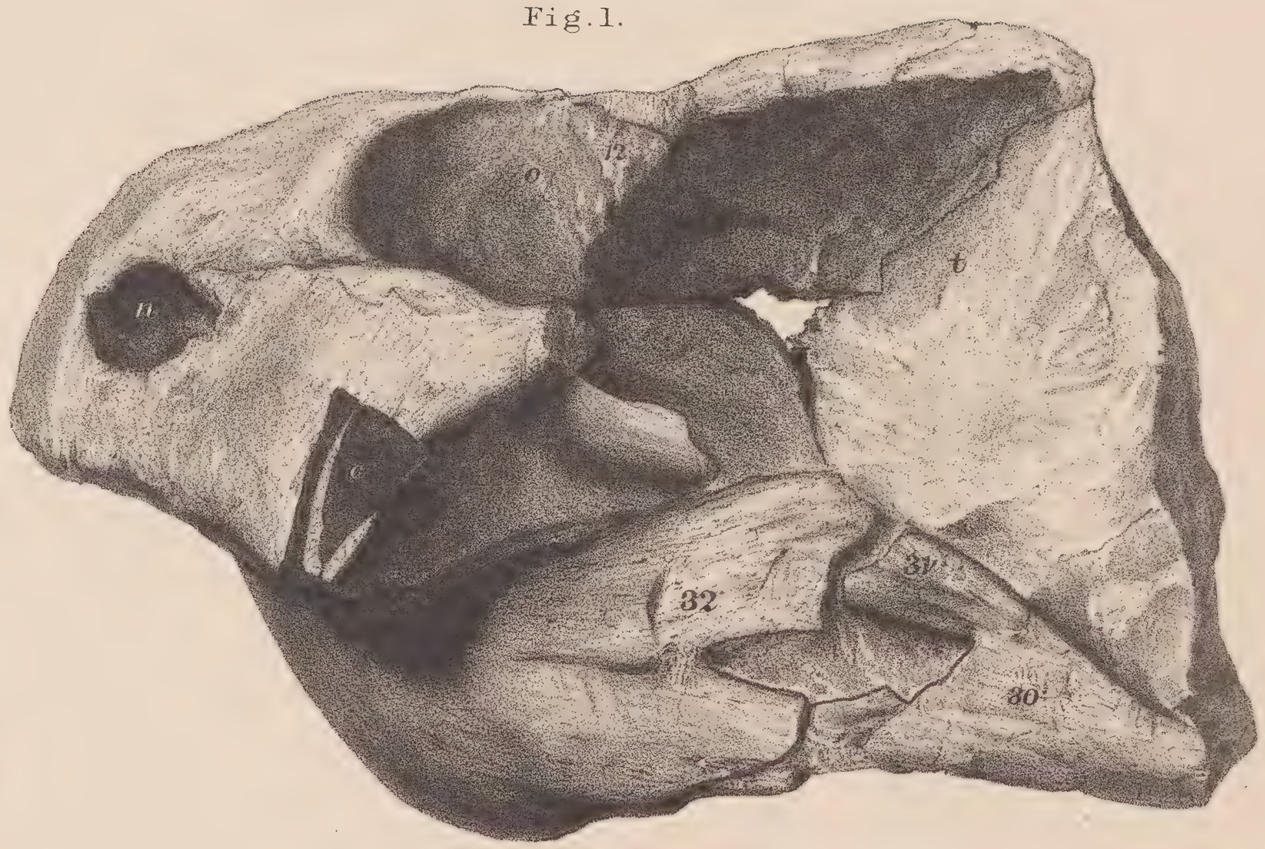


Fig. 1.



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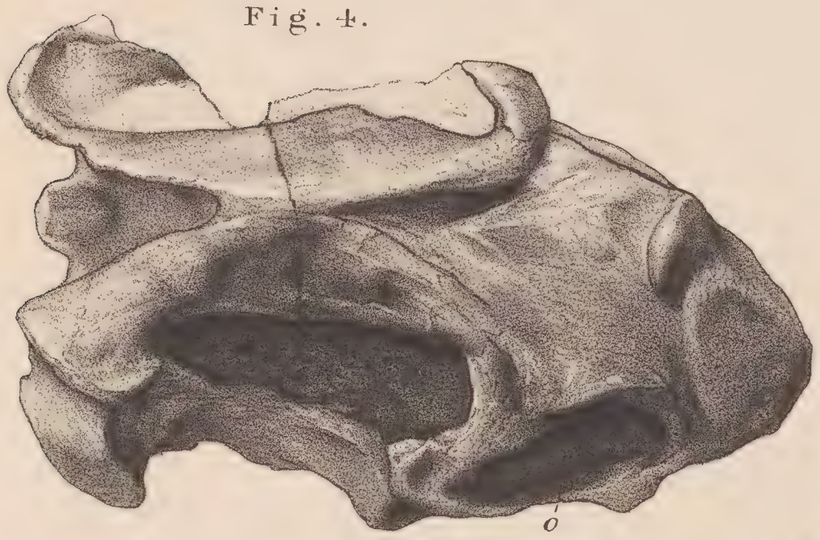

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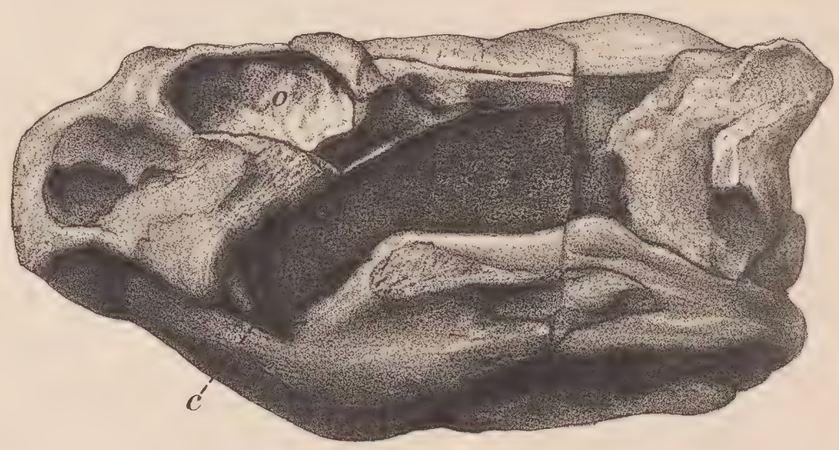

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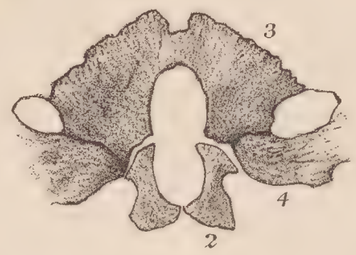

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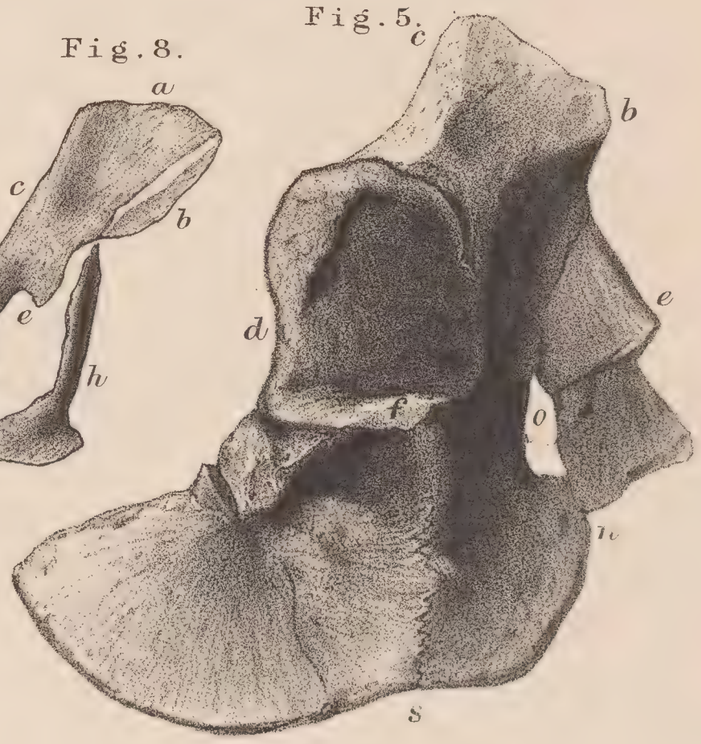

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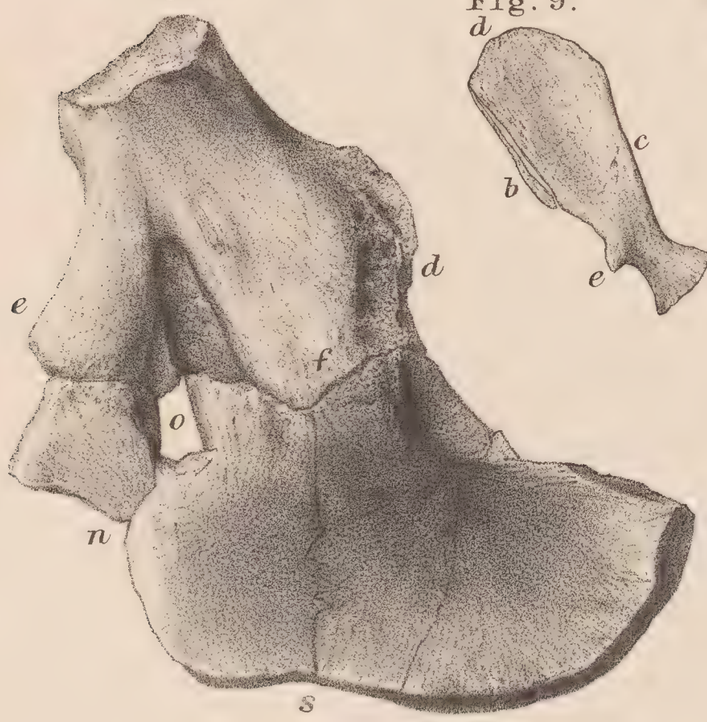

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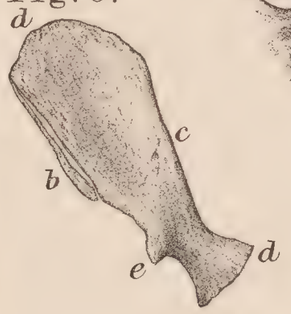

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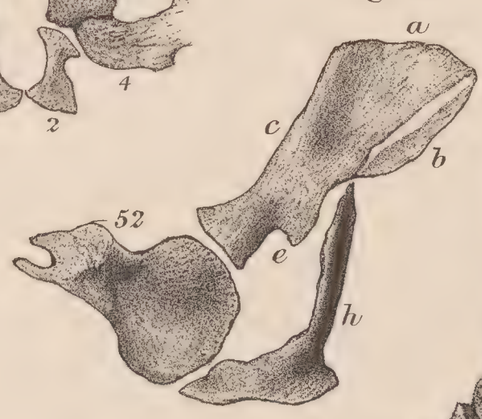

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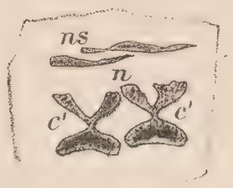

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Figs. 1, 2 Dicynodon dubius; 3, 4 Dicynodon recuroidens; 5, 6 Dicynodont; 7–10 Kistecephalus.

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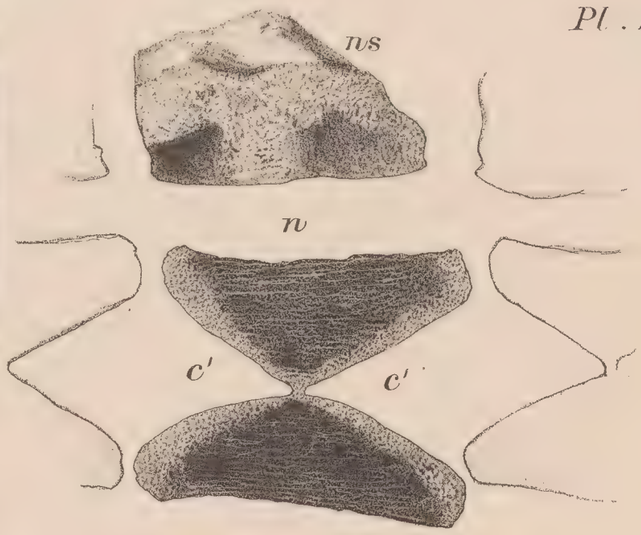
Fig. 1.

Fig. 2.



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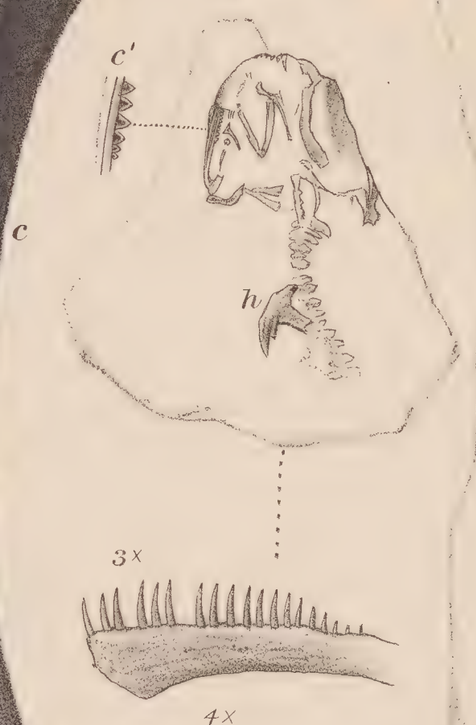

Fig. 4.

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Fig. 1 Dicynodon leoniceps; 2 Anthodon serrarius; 3 Saurosternon Bainii; 4 Saurosternon Griesbachii.

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